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ANNUAL REPORTS

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE YEAR ENDED JUNE 30,

1908.

REPORT OF THE
SECRETARY OF AGRICULTURE.

REPORTS OF CHIEFS.

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* * * * * * *

Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

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REPORT OF THE SECRETARY OF AGRICULTURE.

REPORT OF THE SECRETARY OF AGRICULTURE.

Mr. President:

I respectfully present my Twelfth Annual Report, covering the work of the Department of Agriculture for the year 1908.

The crops of the year and the other products of the farm first claim attention, after which the work of the Bureaus and other offices of the Department, in and outside of Washington, is summarized. Then follows a review of the progress of agriculture in this country during the last twelve years, with concise statements of the principal causes and the more prominent results.

AGRICULTURAL PRODUCTION IN 1908.

TOTAL VALUE.

Billions upon billions the farmer has again piled his wealth. Production has been above the average of recent years all along the line, with few exceptions, and some prices have been up while others were down. After offsetting losses against gains, in comparison with 1907, there remains a net gain which raises the total value of all farm products of 1908 to the most extraordinary amount in the world's history, $7,778,000,000.

This value is the result of estimates for all products itemized by the census and is based upon the census plan of valuation. While it includes some duplication, on the other hand it does not include some important items of wealth production, and the fact remains that the unthinkable amount of 7¾ billions of dollars of wealth have been produced by farmers this year for national sustenance and for export to the craving millions of foreign nations.

It is real, tangible wealth as it exists at the time it leaves the hands of the producer. It is about four times the value of the products of the mines, including mineral oil and precious metals. From these agricultural products the manufacturing and mechanical industries that use agricultural products as materials draw 86.8 per cent of their total materials, and these industries use 42 per cent of all materials used in the entire business of manufacturing. These figures indicate the extent to which the manufacturing industries are indebted to agriculture, although no recognition is given to this fact in usual statements of the value of manufactures.

INCREASE ABOVE FORMER YEARS.

The farm value of farm products this year is $290,000,000 above the value for 1907, $1,023,000,000 above that of 1906, $1,469,000,000 above that of 1905, $1,619,000,000 above that of 1904, $1,861,000,000 above that of 1903, and $3,061,000,000 above the census amount of 1899.

Expressed in the form of percentages of increase, the amount for 1908 was 4 per cent greater than that for 1907, 15 per cent over that for 1906, 23 per cent over that for 1905, 26 per cent over that for 1904, 31 per cent over that for 1903, and 65 per cent over that for the census year 1899.

A simple series of index numbers shows the progressive movement of wealth production by the farmer in another form. The value of products in 1899, the census year, being taken at 100, the value for 1903 stands at 125, for 1904 at 131, for 1905 at 134, for 1906 at 143, for 1907 at 159, and for 1908 at 165.

During the last ten years the wealth production on the farms of this country has exceeded the fabulous amount of $60,000,000,000.

CHIEF CROPS.

In the statement that follows concerning the crop quantities and values for 1908 no figures should be accepted as anticipating the final estimates of this Department to be made later. Only approximations can be adopted, such as could be made by any competent person outside of this Department.

CORN.

Greatest of all crops is Indian corn, the priceless gift of the Indian, who freely gave to the white man information which led to the production of 2,643,000,000 bushels this year. The crops of three years have exceeded this, but only the crop of one year—1906—exceeded it very much.

The value of this crop almost surpasses belief. It is $1,615,000,000. This wealth that has grown out of the soil in four months of rain and sunshine, and some drought, too, is enough to cancel the interest-bearing debt of the United States and to pay for the Panama Canal and 50 battle ships.

The price of corn is exceptionally high. There are only two years in the records of this Department in which the farm price of this crop was as high as it is for this year. In 1881 the price was 63.6 cents; in 1901, when there was only two-thirds of an ordinary crop, the price was 60.5 cents.

The total value of this crop is by far the highest ever reached. The crop of 1902 was worth a billion dollars, and the crops of 1904, 1905, and 1906 were worth $100,000,000 more; the great increase of $300,000,000 over the crop of 1902 was made in 1907, and now the increase is $600,000,000, equal to the gold in the treasury of a rich nation.

The corn crop far exceeds in value the prominent farm crops next below. It is worth nearly as much this year as the great crops of cotton, hay, and wheat combined.

In comparison with the averages of the preceding five years, the quantity of the corn crop of this year is 2.1 per cent higher and the value 42.6 per cent higher.

COTTON.

Commercial interests have agreed upon a large cotton crop for 1908–9, and, accepting their opinion for the moment, it seems likely that the crop stands with the highest three years in quantity. In value, however, it is apparently next to the highest, and perhaps equal to that, although the farm price of cotton this year is below the price of last year by more than 1 cent.

The average cotton crop of the preceding five years is considerably exceeded by the crop of this year, yet the value this year is hardly above the five-year average.

For the first time in the history of this country's agriculture the value of the cotton crop, including the seed, has apparently exceeded the value of the hay crop, which has heretofore held second place for a long series of years.

HAY.

The reason the value of the hay crop has lost its relative place in the scale of crop values is that the price is low because of high production. The price this year at the farm is more than $2 per ton less than it was a year ago; so that, although the number of tons harvested this year was 68,000,000, or 11.7 per cent above the average of the preceding five years, the total value is but $621,000,000, or only 5.7 per cent above the five-year average. Otherwise compared, the hay crop is the largest ever produced in this country, and its total value has been exceeded but once.

WHEAT.

Wheat is 1.5 per cent above the five-year average in production and 23.3 per cent above that average in total value. The story would have been somewhat different had this country depended upon spring wheat alone, since that crop suffered considerably because of the drought.

In quantity the wheat crop is 660,000,000 bushels, and has been often exceeded, while the value is $620,000,000, and was never equaled, nor approached nearer than $66,000,000.

OATS.

The fifth crop in value is oats, with a total of $321,000,000, or 9.6 per cent above the five-year average. The quantity, however, was 9.3 per cent below the five-year average, and was represented by 789,000,000 bushels, the low amount being due to protracted drought. In only one year, 1907, has the total value of the oat crop exceeded the value this year, but the quantity has often been exceeded.

BARLEY.

The cereal crop next below oats in value is barley, with a production of 167,000,000 bushels, worth $86,000,000 at the farm. The number of bushels and their value have been exceeded only once, but in a comparison with the averages of the preceding five years the production is higher by 13 per cent and the total value by 22.6 per cent.

RYE.

Rye is a crop that has remained steady at a production of about 30,000,000 bushels or a little more in recent years, and the crop of this year is higher in comparison with the five-year average by only 3 per cent, although the total value is higher by 17 per cent. This value is about $22,000,000, which has been exceeded three times.

RICE.

The large rice crop of this year, 23,000,000 bushels, gives it a value close to that of the rye crop, or about $18,000,000. This is 28.7 per cent above the average of the preceding five years in quantity and 22.7 per cent above it in value.

No year has produced such a rice crop as this one in quantity, nor has the rice crop of any former year been worth as much to the producer.

ALL CEREALS.

When buckwheat is added to the cereals above mentioned, interesting totals are provided. While all of these cereals are measured by the bushel, they are not fully comparable one with another on this basis; but, after all, in the grand aggregate of bushels of cereals there is some indication of comparative production, one year with another.

The total quantities of cereals produced in this country this year is 4,329,000,000 bushels, an amount that has been exceeded three times.

The value of all cereals reaches the grand total of $2,694,000,000, an amount that is more than $300,000,000 above that of last year, and still greater than in former years.

In the five-year comparison, the number of bushels of cereals this year is higher by 0.2 per cent, and the value is higher by 32 per cent.

POTATOES.

On account of the unfavorable weather, the potato crop of this year is low in quantity, 275,000,000 bushels, being 5.1 per cent below the five-year average and having often been exceeded by crops of former years. In value, however, $190,000,000, this crop is 18.1 per cent above the five-year average and was never equaled in any other year.

SUGAR BEETS AND CANE.

In the production of sugar beets for sugar making, this year stands at the top, both in quantity and in its value to the farmer, although in both respects not much above the figures for 1906 and 1907; but, in comparison with the average of the preceding five years, the tonnage of this year is higher by 44.7 per cent and the value, $21,500,000, by 43.7 per cent.

The plantation value of sugar cane, molasses, and sirup for 1908 is estimated to be about $34,000,000, a value which was exceeded only in 1904, but in comparison with the five-year average the value is greater this year by 9.7 per cent.

The foregoing figures relate to raw materials of sugar, but it is always interesting to notice the estimates of the values of the finished product, or refined sugar for beets and raw sugar for cane.

The beet-sugar production from the crop of 1908 reaches a higher figure than ever before, or about 500,000 short tons, worth at the factory, with the pulp, about $45,000,000; this value also is higher than for any preceding year.

In the case of the raw sugar of cane, the production of 1908 has a commercial estimate of about 407,000 short tons, a quantity perceptibly greater than the high figures of four or five former years. The value of this product has been exceeded in only one year, 1904.

The value of the sugar beet and of the sugar cane to the grower, with the addition of such molasses and sirup as are made on the farm and outside of factories, makes a total of about $56,000,000 for 1908.

On combining beet sugar with cane sugar, the total production of 1908 is estimated to be about 900,000 short tons, an amount much above the total of the highest former year; the factory value of the two kinds of sugar is supposed to be $75,000,000, and this holds the record place.

The grand total value of the refined sugar of beets, of the raw sugar of cane, of beet pulp, of molasses and sirup of cane and sorghum, and of maple sugar and sirup, resulting mostly from commercial estimates, is $94,000,000 for 1908.

TOBACCO.

Tobacco production has been low for several years on account of a depression in price, but the price rose considerably in 1907 and is perhaps still higher this year. Apparently the value of the tobacco crop to the farmer this year is at least $70,000,000, or about the value of 1907, and much higher than in preceding years.

While the crop is under the five-year average in quantity, its value is over 15 per cent higher.

HOPS.

The extremely low price of hops in 1907 caused a great reduction in the acreage of 1908, with the result that the commercial estimate of the crop is 39,000,000 pounds, the value of which is about $4,000,000, both amounts being exceeded in many former years.

In comparison with the preceding five years, the quantity of the hop crop is lower by 27.6 per cent and the value by 42.9 per cent.

ALL FARM CROPS.

For the first time, the value of all farm crops this year equals $5,000,000,000, and of this total the value of the corn crop is about one-third; wheat, hay, and cotton combined make more than one-third; and the smaller crops the remainder, or nearly one-third.

The crop production for the year is on the whole a high one. Never before was the hay crop so large in quantity, nor the rice crop, nor the sugar-beet crop, nor beet and cane sugar production. The production of barley has been exceeded in only one former year, and cotton has been exceeded by only two years at the most.

With regard to crop values, this year leads all former years in the case of corn, wheat, rice, all cereals, potatoes, sugar beets, beet sugar, beet and cane sugar combined, and possibly tobacco.

Next to the highest value, in comparison with former years, was reached by cotton, hay, barley, oats, sugar cane, and cane sugar.

In comparison with the preceding five years, crop production has been higher for every crop mentioned above except oats, flaxseed, potatoes, tobacco, and hops; values were higher than the average of the preceding five years for every crop except cotton seed and hops.

Notwithstanding two or three rather alarming periods of drought during the growing season, after all, the crop production of the year stands high, although not extraordinarily so, and the level of values is high.

ANIMAL PRODUCTS.

To the farmer who has averaged hardly 20 cents a pound for the butter that he has sold, between 3 and 4 cents a quart for his milk, and about 1½ cents for each egg, and even to the consumer who has paid prices much above these, it is a striking fact that the value of the farm products of the dairy cow are getting closer and closer to $800,000,000, and that the eggs and poultry produced on the farm are worth as much as the cotton crop, seed included, or the hay crop, or the wheat crop.

These advances in value are not due solely to increase in number of cows and of poultry, but considerably also to advances in price. The mean factory price of Elgin butter was 19.66 cents in 1899, 28.5 cents in 1907, and 27.16 cents in 1908. The mean farm price of eggs throughout the United States was 11.15 cents in 1899, 17.02 cents in 1904, and 18.3 cents in 1908. The wholesale milk prices at Chicago and New York, respectively, were 10.5 and 10.12 cents per gallon in 1899, 12.24 and 11.76 cents in 1905, 14.375 and 12.886 cents in 1907, and 15.16 and 16.62 cents in 1908.

The mean wholesale price of dressed poultry in New York was 11.15 cents per pound in 1899, 12.97 cents in 1903, 14.9 cents in 1907, and 13.56 cents in 1908.

The aggregate value of animals sold and slaughtered increases year by year because of increasing number and also because of a rising price level, although in the case of some classes of animals prices fall at times.

In the aggregate the value of animals sold and slaughtered and of animal products at the farm amounts to about three-eighths of the value of all farm products, estimated upon the census basis. This value is getting closer and closer to $3,000,000,000.

FOREIGN TRADE IN AGRICULTURAL PRODUCTS.

EXPORTS.

Never before in the foreign trade of this country have the exports of domestic agricultural products been as valuable as they were in the fiscal year ending June 30, 1907, but the amount was only $37,000,000 below that amount in 1908, when the value of these exports was $1,017,000,000, or greater than for any year except 1907.

The falling off in exports in 1908 was due mostly to cotton, which showed a decrease of $43,000,000, a loss which was partially offset by an increase of $31,000,000 in exports of grain and grain products.

By far the largest item or group of agricultural exports was cotton, with a value of $438,000,000; next, grain and grain products, $215,000,000; and, third, packing-house products, valued at $196,000,000.

IMPORTS.

The loss in imports of agricultural products in 1908, compared with 1907, was $87,000,000, or much more than the loss of exports, the principal item of decrease being packing-house products; on the other hand, there were increases, chief among which were fruits and vegetables.

The principal items of import in 1908 were silk, $65,000,000; wool, $24,000,000; packing-house products, such as hides, etc., $66,000,000; coffee, $68,000,000; various vegetable fibers, $50,000,000; fruits, $28,000,000; vegetable oils, $16,000,000; sugar and molasses, $81,000,000; tea, $16,000,000; and tobacco, $23,000,000.

The total imports of agricultural products in 1908 were valued at $540,000,000 in the countries from which they were exported, a decrease of $87,000,000 from the amount of 1907.

TRADE IN FOREST PRODUCTS.

A decrease of $2,600,000 was the result of the export trade of this country in forest products of domestic production in 1908 as compared with 1907, due mostly to a decrease in value of exports of lumber and, in a less degree, of timber.

There was a diminution also in the value of imports of forest products in 1908 compared with 1907, the loss being $24,000,000, found almost entirely in india rubber. There was a gain of $2,000,000, however, in the value of pulp wood and of $1,000,000 in wood pulp.

COMPARISON OF CLASSES OF EXPORTS.

On account of the sudden expansion of exports of manufactured products during the fiscal year 1908 the fraction of the value representing agricultural products and commodities whose manufacture is sustained mainly by agricultural materials declined somewhat in comparison with recent years and is now 61.5 per cent, while the fraction for forest products and for commodities whose manufacture is mostly sustained by forest products as materials is 7.8, and the fraction for exports that are not agricultural, nor of forest origin, either fully or in principal degree, is 30.7.

Animals and animal products contributed 16 per cent to the value of the total exports of 1908; cotton and cotton products, 26.9 per cent; grain and grain products, 12.2 per cent; all other products chiefly sustained by agriculture, 6.4 per cent.

BALANCE OF TRADE.

The exports of domestic farm products in 1908 being worth $1,017,000,000, the exports of foreign products being over $10,000,000, and the imports of farm products being $540,000,000, a balance of international trade in favor of the farm products of this country results, with the enormous value of $488,000,000.

During the same period the balance of trade in products other than those of the farm was $178,000,000, or an amount that has not been equaled within the memory of man. The agricultural balance was exceptionally high and has been equaled only in 1901 and 1898. The magnificent figures of the farmers' contribution to the exports of this country and to the favorable balance of trade are maintained in spite of this country's immense growth in population and extraordinary immigration of nonagricultural peoples, and also in spite of the diminishing fraction of the population that is engaged in agriculture. No analysis could more strongly indicate the progressive efficiency of the farmer's labor and capital and the telling effects of the agricultural sciences.

FOREIGN TRADE OF MORE THAN HALF A CENTURY.

AGRICULTURAL EXPORTS AND IMPORTS.

A compilation of the foreign trade of the United States in agricultural and forest products has just been completed as far back as the fiscal year 1851, and for the first time the general results are here made public. Annual averages by five-year periods are used for better understanding.

In 1851–1855 the exported agricultural products of domestic origin were valued at $150,000,000, and in the five years just before the civil war at $229,000,000. After that war the amount steadily grew by five-year periods to the great value of $875,000,000 in 1901–1905 and afterwards to $1,054,000,000 in 1907, the highest year of all.

The exports of agricultural products of foreign origin increased from $8,000,000, the annual average for 1851–1855, to $12,000,000 in 1901–1905, an amount that was not equaled in subsequent years.

The value of the imports of agricultural products at the beginning of the period under review was $68,000,000, as the annual average for 1851–1855. The average was progressive to the last period, with the exception of two five-year periods, and for the five years 1901–1905 it averaged $455,000,000. The highest amount ever reached was $627,000,000 in 1907.

Upon striking a balance of trade the evidence of the most remarkable power of the farmers of this country to produce a national surplus is brought out forcibly. For the first period, 1851–1855, the annual average balance in agricultural products in favor of this country was $89,000,000; the civil war diminished this, but the rise afterwards was fairly steady but firm until the period of 1896–1900, when there was a quick increase in the balance to $387,000,000, after which the amount has been always more than $400,000,000, except in 1905, and in 1901 it was $571,000,000, the highest amount in history.

During the entire period until 1898 the farmer provided this country with a balance of trade in his own products which offset a part or all of the unfavorable balance in the international exchange of commodities other than agricultural. After struggling with the load for a quarter of a century, he was able to overcome the adverse balance in commodities other than his own in 1876, when he began to produce a favorable balance of trade in the total of all commodities, steadily, year after year, with the exceptions of 1888, 1889, and 1893.

The per capita values of the exports of agricultural products expressed in annual averages by five years show that they have more than doubled during the half century under review. The per capita value during the period 1851–1855 was $5.84, and this average grew with several irregularities to $10.88 for 1901–1905 and to $12.29 for 1907, the highest amount of record.

On the other hand, the per capita value of the imports of agricultural products increased from $2.67 for 1851–1855 to $6.25 for 1871–1875, an amount that was not equaled by any subsequent five-year average. The average for 1907 was $7.30, which was higher by $1.05 than the great annual average for 1871–1875.

FOREST PRODUCTS.

The value of the exported forest products of domestic origin has steadily increased during the fifty-eight years under review. Beginning with an annual average of $6,000,000 in 1851–1855, these exports steadily increased in value to $28,000,000 in 1891–1895, after which the rise was rapid to $59,000,000 in 1901–1905, and to $93,000,000 in 1907, which was nearly equaled in 1908.

The per capita average of these export values was 24 cents in 1851–1855 and $1.08 in 1907.

Imports also of forest products have enormously increased in value during the fifty-eight years. They were valued at $2,000,000 as the average for 1851–1855, at $72,000,000 for 1901–1905, at $122,000,000 for 1907, by far the highest amount, and the value for 1908, $98,000,000, was next high.

The per capita value of those imports was 8 cents for 1851–1855 and $1.43 for 1907.

Rosin has increased in quantity of exports from the beginning to the end of the fifty-eight-year period, the number of barrels exported annually in 1851–1855 being 525,000, the number in 1901–1905 being 2,530,000, and in 1908, 2,713,000.

The exports of spirits of turpentine increased in a much greater degree than the foregoing, or from 1,000,000 gallons in 1851–1855 to 18,000,000 gallons for the ten years 1896–1905, after which there was a reduction to 16,000,000 gallons, but the greatest exports for any year were nearly 20,000,000 gallons in 1908.

Wood pulp has declined steadily in exports, the average for 1896–1900 being 45,000,000 pounds. It was 35,000,000 pounds in 1901–1905, 29,000,000 pounds in 1906, 25,000,000 pounds in 1907, and 24,000,000 pounds in 1908.

Imports of various items of forest products gain interest in a review for as long a period of time as fifty-eight years. Imported wood pulp averaged 42,000 tons in 1891–1895, and the gain was steady to 213,000 tons in 1907, and to 238,000 tons in 1908.

The pounds of imported india rubber rose from 38,000,000, the average for 1891–1895, to 77,000,000 in 1907, which was not equaled in 1908.

Imported cabinet woods increased steadily from an average of $515,000 in 1851–1855, to $5,000,000 in 1907, and the imports of timber and lumber other than cabinet woods were multiplied six times in value from 1856–1860 to the present time.

The farmer had many reasons for his Thanksgiving in 1908, as he had in recent former years. He has reaped as well as sowed. He has obtained more of the means with which to improve his farm, to increase his capital, to become a more generous consumer of the goods of other producers, and to add to the things that count for a better living and a more pleasant life.

THE DEPARTMENT'S WORK IN 1908.

LEGAL OPERATIONS.

Owing to the Department's duties in the enforcement of the food and drugs act, the new meat-inspection law, and the amended twenty-eight-hour law, together with the increasing scope and complexity of the Department's operations, the Office of the Solicitor has within the last two years assumed greatly increased importance.

In all cases in which punishment for violation of law is sought the course of procedure is for the Solicitor to prepare a statement of the case for transmission by the Secretary of Agriculture to the Attorney-General. The prosecutions are begun and carried on by the United States attorneys in the various judicial districts. In many cases, however, the Solicitor has examined authorities, prepared briefs, and assisted in adducing evidence.

ENFORCEMENT OF THE TWENTY-EIGHT-HOUR LAW.

During the year a very large number of cases have been brought, at the instigation of this Department, against various railway companies for violations of the twenty-eight-hour law, which limits the number of hours during which a shipment of live stock may be kept in cars without unloading. In 401 of these cases penalties were imposed amounting in all to $61,530, and costs were assessed amounting to $7,201.70, and 828 cases were pending at the close of the year.

OFFENSES AGAINST QUARANTINE LAWS.

For the failure to properly placard cars containing shipments of southern cattle from below the quarantine line, 33 cases were reported to the Attorney-General, and favorable decisions in 25 of these cases resulted in penalties aggregating $2,400 and costs amounting to $123.83. Fines of $100 and costs were imposed in each of 4 cases against individuals for illegally removing southern cattle out of the quarantine area. For infractions of the law for the suppression of contagious diseases of animals, 8 cases were reported to the Attorney-General, the offense in each case consisting in the illegal shipment of sheep infected with scabies.

ENFORCEMENT OF FOOD AND DRUGS ACT.

At the beginning of the year no case had been brought for violation of the food and drugs act of June 30, 1906, although the machinery for the enforcement of the act had been created. During the year, however, 135 cases were reported to the Attorney-General, 97 of these being for criminal prosecution and 38 for seizure and condemnation. Of the criminal cases, 14 have resulted in convictions, the fines ranging from $5 to $700 with costs. Of the 38 seizure and condemnation cases, 14 resulted in forfeiture and condemnation. So far not a single case has been decided adversely to the Government.

The Solicitor has devoted much time and attention to the work of the Board of Food and Drug Inspection, of which he is a member. The consideration of questions submitted to the board for determination and the preparation of "Food Inspection Decisions" for the instruction and guidance of those who desire to conduct their business in strict conformity with this law have occupied much time and have been of far-reaching importance in securing compliance with the provisions of this act. Twenty-three of these decisions were prepared and published during the year. One of these (F. I. D. No. 86, "Original Packages"), prepared by the Solicitor, covered the relation of the original package to interstate commerce, and its preparation involved a careful review of all the leading Federal cases on the subject of interstate commerce. This decision has met with a most favorable reception by the legal profession and has been of great value to United States attorneys in handling cases under this act.

VIOLATION OF GAME LAWS.

Under the Lacey Act governing interstate shipment of game, 7 cases were reported to the Attorney-General for prosecution; also 4 cases for the unlawful killing of game in Yellowstone Park. Two of these cases were decided in favor of the Government and others are pending.

MISCELLANEOUS CASES.

The Solicitor gave attention to four cases in the Court of Claims in which the Department was interested. He submitted the evidence used in securing conviction of a former employee of the Department for inserting false and fraudulent items in his expense account, the guilty party receiving a sentence of $1,000 fine and thirty days in jail. In several cases employees of the Bureau of Animal Industry engaged in meat inspection and field work have been assaulted and roughly handled while in the proper performance of duty. In all such cases it is the policy of the Department to vigorously defend its agents, and to use every effort to secure punishment of such offenders. In one case during the past year a ranchman in Wyoming was fined $500 and given three months in jail for brutally assaulting an inspector who refused to falsely certify that the offender's cattle had been dipped. For an attack on an agent engaged in tick-eradication work in Tennessee two offenders were fined $150 each. For an assault on a meat inspector in Indiana the guilty parties were fined $100 each.

LEGAL PAPERS—PUBLICATIONS.

The preparation and examination of legal papers—bonds, contracts, leases, etc.—occupy an important place among the duties of the Solicitor. The contracts receiving attention during the past year numbered 374 and the leases 377.

A compilation of the laws affecting the Department of Agriculture, made in the office of the Solicitor and published with an exhaustive index, has proved extremely useful to officers of the Department. A series of circulars has been started and seven numbers issued, containing reports of judicial decisions in cases involving the twenty-eight-hour law. The object in publishing these circulars was to make these decisions immediately available for the use of United States attorneys handling cases against alleged violators of this law. The value of these circulars has been abundantly demonstrated.

OFFICERS AND EMPLOYEES.

On July 1, 1908, as shown by the report of the Appointment Clerk, there were on the rolls of the Department 10,420 persons, 2,488 employed in Washington and 7,932 outside of Washington. The net increase in the Department force during the year was 1,313. The total number of appointments was 17,819. Of these 15,991 were to temporary or emergency positions, chiefly in the grade of laborer, continuing in most cases not more than three months and in many cases not more than one month, the great majority to positions outside of Washington. Resignations numbered 574, deaths 41, removals for misconduct 41, and separations from the unclassified service 31, while 128 persons declined to accept appointments. By far the largest increase, 741, is in the Forest Service. Positions on the statutory roll (those prescribed by the appropriation act) number 1,161, while 9,259 are on the lump-sum roll. More than 2,600 members of the Department may properly be classed as scientists. Contingencies arising in the Department's field work—demonstration farming, meat inspection, food inspection, protection of the National Forests from trespass and from fire, cattle-tick eradication, moth eradication, and insect fighting—account largely for the temporary appointments.

NEW BUILDING OPERATIONS.

The new Department building was completed during the year. While the contract date for the completion of the general construction work was November 29, 1907, the work was not finished until four months after that date. On March 17, 1908, the building was accepted subject to the completion of several minor items of unfinished work, and steps were immediately taken toward its occupancy by the various Bureaus of the Department, which were very inadequately housed in scattered buildings rented by the Department. All of the general construction and mechanical equipment work has been satisfactorily completed, and final payments have been made thereon. Since July 1, 1908, contracts have been let for an additional boiler, for mechanical stokers, and for vacuum cleaning machinery for the new building. The boiler has been completely installed, as have the stokers, which permit the use of bituminous coal without smoke, at a much less cost than anthracite coal. The vacuum cleaning machinery is now being installed.

The Building Committee of the Department has been dissolved, but has been succeeded by a Committee on Buildings, whose attention is being devoted not only to the new building but to the old quarters as well. Several structures in close proximity to the new building have been or will be removed, in accordance with the provisions of the original plan and appropriation for the building work. In carrying out this plan new quarters for shops, stables, and storage are being erected on the north side of the Department grounds, for which purpose a special sum was appropriated by Congress at its last session.

WEATHER BUREAU.

FORECASTS AND WARNINGS.

A few years ago the Department undertook to establish a research station at Mount Weather, Va., for the investigation of the problems of the air. This institution was planned to meet the highest requirements of science, and at the same time had as an object the acquirement of additional knowledge bearing directly on the forecasting of the weather. Heretofore the forecasts made by the Weather Bureau have been based entirely on the conditions of the air as observed at the surface of the earth, but for several years the Mount Weather station has been sending meteorological instruments into the upper levels of the atmosphere to find out what is going on there, and to obtain, if possible, additional information for the use of the weather forecasters at Washington in making their predictions. This object is now being realized, and the securing of data every day at altitudes of from 1 to more than 4 miles marks an important epoch in the work of the Weather Bureau.

Some of the conditions disclosed by these upper air observations are quite interesting. At times the temperature at an elevation of several thousand feet has been found to be as much as 15° higher than at the surface of the earth. Again, the kites carrying the instruments would pass through swiftly moving air at the surface, only to encounter a stagnant condition at higher levels. Often what appeared to be a deep covering of clouds would prove to be only a thin layer, while in other cases the kites have traveled through a cloud mass more than a mile in thickness, the automatic register of temperature indicating when the kites entered and when they emerged from the cloud stratum. All of the data thus gathered have an important bearing on the coming weather conditions for the middle Atlantic and New England States, and are therefore telegraphed to Washington each evening for consideration by the forecaster. At times, especially during the prevalence of unexpected conditions such as have just been noted, they have prevented erroneous deductions that would have arisen from a study of surface conditions alone, and have thus materially added to the efficiency of the Weather Service.

The electric and magnetic conditions of the earth and air are continuously recorded at the Mount Weather research institution. Observations are being made with a view to determining the amount of heat in the atmosphere, and studies of the temperature at the earth's surface and of the various forms of energy that reach us from the sun are being carried on. An effort is being made to discover the relation between these various conditions and our weather, although we have not yet learned how best to interpret and apply all the data thus being secured.

It is a matter of gratification to the Department to know that the development of the Weather Service has been such as to attract attention abroad. To such a degree is this true that during the past ten years representative scientists have been sent by the Governments of nearly all of the more advanced nations to study our system, and more especially of late to learn what we are doing at our research institution at Mount Weather. There are now on duty at the Weather Bureau several students sent to us by other countries, pursuing their studies under the professors of our Bureau.

Another important departure, made possible by continued study of the science underlying the art of weather forecasting, is the making of long-range weather predictions. These were begun for practice purposes, but not for publication, about one year ago. Their accuracy became so marked that within the past few months these predictions have been given to the public. An instance of their value, equally demonstrated on many other occasions, is found in the case of the drought that covered the greater part of the country from the Rocky Mountains eastward during August and September, 1908. On September 22 the Bureau announced that early in the following week general rains would set in over the Rocky Mountain Plateau and extend eastward. This prediction was fully verified, a general fall of rain occurring over the entire drought-stricken district within less than half a week after the prediction was made. We do not wish to hold out too alluring a prospect with regard to forecasts of this character, for at times the condition of the atmosphere may be such that long-range predictions can not be made, but we have demonstrated that in the majority of cases we can foretell a week in advance, and with a high degree of accuracy, the general character of the weather that is to come.

This gratifying result has been attained not only by getting observations from the higher levels of the atmosphere, but more especially by the securing of daily telegraphic reports covering the entire northern hemisphere, these being used in the preparation of a meteorological chart of such detail and extent as is attempted by no other weather service in the world. The value of these forecasts to the agricultural and other industries of the Nation can hardly be measured.

All severe storms on the American coasts and lakes and all severe cold waves and frosts in any portion of the United States during the year were successfully forecast.

NEW APPARATUS.

The increasing demands on the Bureau for various meteorological data require almost yearly the invention of new apparatus. During the past year these demands have been met in part by the preparation of the following:

(1) A chart and instrument kiosk, or booth. This is an instrument shelter especially designed for location in the business and news centers of large cities on the street level at places accessible to the public. It will contain and display instruments that indicate and record meteorological conditions, especially temperature and humidity, and will also be used for the display of climatic charts, weather maps, and forecast cards.

(2) A recording hygrometer for stations. This instrument automatically registers the moisture content of the air, which is one of the most important meteorological elements requiring observation.

(3) A telethermoscope. This device, which is constructed for installation within a building, indicates the temperature of the outside air. By its use the Weather Bureau officials are enabled to respond immediately to the frequent requests received for temperature data, without having to visit the instruments.

RIVER AND FLOOD SERVICE.

With each succeeding year the development of agricultural operations and the extension of business interests more or less dependent upon river stages necessitate some broadening of the field of activity of the River and Flood Service, and during the present year new work has been undertaken as follows:

(1) The establishment of a continuous flood-warning service, operating day and night in times of flood, in that portion of the State of West Virginia bordering on the Ohio River.

(2) The establishment of a new river district center at Binghamton, N. Y., with territory comprising that portion of the watershed of the Susquehanna River at and above Binghamton. This territory was formerly a portion of the Harrisburg, Pa., district.

(3) The opening of new river stations in the watershed of the upper Cumberland River, in the interest of navigation and the lumber industries.

(4) The opening of several new stations at scattered places throughout the country, in order to secure increased efficiency in the flood-warning service.

Realizing the fact that the art of river forecasting is dependent upon the intelligent use of data of diverse kinds, and that the exigencies of the Weather Bureau service frequently render it impossible for officials in charge of river districts to systematize and preserve for future use their knowledge of the regimen of the rivers in their districts, the river and flood branch of the central office at Washington has begun, in cooperation with the district officials, an exhaustive study of the problem. The Ohio River and its principal tributaries as far south as Cincinnati, Ohio, have thus far been studied, and the results in elaborate form have been transmitted to the officials in charge of the various districts for actual use in river forecasting. It is hoped that the scheme for the entire Ohio River, and possibly a portion of one for the Mississippi River, can be completed within another year. The work is necessarily slow, as it involves the discussion of a large amount of data.

METEOROLOGICAL RECORDS.

A new series of climatological papers is being prepared, in which the records of precipitation, temperature, dates of the first and last killing frosts, and prevailing wind directions are collected, the precipitation tables including all available data since the year 1871. These reviews are made comprehensive for small sections of the United States, which it is intended gradually to cover in this manner. The papers will be of value to agriculturists, engineers requiring data on water resources, and other citizens who seek information regarding the climate of the several sections.

WATER RESOURCES.

A demand for a better knowledge of the water resources of the United States has become so urgent as to make it advisable to put forth special efforts to supply the necessary data to the public. In the arid and semiarid regions of the West these consist primarily in securing the amount of precipitation from rain and snow in the high levels of the mountains, from which are derived the waters that are used in the storage basins and the irrigation projects now undergoing rapid development. It is a difficult problem to secure regular and accurate observations of the amount of snowfall in the remote regions of the mountains, where there are very few inhabitants, but a special effort will be made by the Weather Bureau to extend the range of observations into the high levels of the mountains.

EVAPORATION STUDY.

In addition to measuring the water resources of the mountains, it is necessary to determine the amount of evaporation in the lower levels, where the storage basins are located. The amount of evaporation in the driest portions of the country, as in the Colorado Desert, may be as much as 8 feet of water annually, although it differs greatly according to circumstances. The importance of securing much more reliable information on this subject has made it desirable to renew the attack upon the problem. The formation of the Salton Sea in the Colorado Desert, by the overflow of the Colorado River during the year 1906, affords a favorable laboratory on a large scale at which to make the proposed research on evaporation. A preliminary study on this subject was conducted by Professor Bigelow in the summer of 1907 at Reno, Nev., for the purpose of securing sufficiently adequate knowledge of the phenomenon to permit a proper planning of the campaign at the Salton Sea. The necessary plant was installed at the Salton Sea during the summer of 1908, and it is hoped that by continuing the observations for two or three years a satisfactory law covering evaporation generally may be secured. The problem is one of unusual difficulty from several points of view, but its practical value is such as to justify a serious effort to resolve it. The plan of cooperation with other Departments of the Government has been enlarged to include the Reclamation Service and the water resources branch of the Geological Survey, which are specially interested in evaporation at the reservoirs not only of the arid portions of the West, but in the eastern districts of the country. During the summer of 1908 several plants for the measurement of evaporation were installed at the reservoirs of the Reclamation Service and if practicable some other reservoirs in the central and eastern districts will be included. It is important to measure the evaporation in different climates on a uniform plan in order that a comprehensive law may be deduced.

THE TEACHING OF METEOROLOGY.

In pursuance of the policy of the Department to aid in eradicating the superstitions everywhere prevailing with regard to the weather, the officials of the Weather Bureau are encouraged in giving popular lectures or explanations, and, when practicable, offering systematic courses of instruction in meteorology. The minor courses for the benefit of high schools have been numerous and are recorded in detail in the successive numbers of the Monthly Weather Review. Regular courses of instruction were given by Weather Bureau officials at fifteen colleges and universities.

BUREAU OF ANIMAL INDUSTRY.

ANOTHER OUTBREAK OF FOOT-AND-MOUTH DISEASE.

For the first time in six years the country has been visited with an outbreak of contagious foot-and-mouth disease, and the Department is now engaged in a vigorous campaign of eradication. The first news of the disease was received by telegraph November 10 from Dr. Leonard Pearson, State veterinarian of Pennsylvania, who reported that it existed in the vicinity of Danville and Watsontown, Pa. On the same day Dr. A. D. Melvin, Chief of the Bureau of Animal Industry, accompanied by Dr. John R. Mohler, chief of the Pathological Division, and Dr. R. P. Steddom, chief of the Inspection Division of that Bureau, left for Danville, and they soon confirmed Doctor Pearson's diagnosis.

A quarantine was immediately declared under date of November 12, effective November 13, against the interstate movement of cattle, sheep, swine, and goats from the counties of Columbia, Montour, Northumberland, and Union, and measures were at once taken in cooperation with the State authorities for stamping out the disease by slaughtering and burying the affected and exposed animals and disinfecting the premises which they had occupied. An arrangement was made by which two-thirds of the appraised value of the animals was to be paid by this Department and one-third by the State of Pennsylvania, other expenses to be shared on the same basis.

Within a few days the disease was also found in several other counties in Pennsylvania and in the vicinity of Akron, N. Y., and on November 19 the quarantine was extended to include the entire territory of the States of New York and Pennsylvania. This quarantine prohibited the interstate or foreign movement of cattle, sheep, and other ruminants and swine from either of the States named. Shipments were permitted by rail through those States provided the cars were sealed by the Bureau of Animal Industry before they entered the quarantined territory. Such shipments were allowed to be unloaded in transit only in pens designated by the Chief of the Bureau and which had been cleaned and disinfected. The shipment of dressed carcasses from the States named was permitted only when the hides and hoofs had been removed, and the shipment of hides, skins, hoofs, hay, straw, etc., was forbidden unless such material had been disinfected by the Bureau.

A plan of cooperation was arranged with the State authorities of New York on the same terms as with those of Pennsylvania.

It was fortunate that the Bureau of Animal Industry had available as part of its regular force a large number of trained veterinarians, many of whom had had experience in the successful campaign against foot-and-mouth disease in New England in 1902–3. A sufficient number of these men were quickly ordered to the infected districts and the work of eradication was actively prosecuted. Not only was the work of slaughtering, burying, and disinfecting carried on, but experts were sent to investigate all rumors indicating the presence of the disease in various localities.

It appeared that the cattle causing the Pennsylvania outbreak came through the Buffalo stockyards, and from Buffalo suspicion pointed to Michigan. Inspectors were dispatched to the latter State, and on November 23 I went to Buffalo in company with the Chief of the

Bureau of Animal Industry to give personal attention to the situation. Evidences of infection from Michigan became so strong that I immediately proceeded from Buffalo to Detroit. On arrival in the latter city on the night of November 24, positive reports were received from our inspectors that the disease existed in several herds in Wayne County, and I at once declared a quarantine on the State of Michigan, to take effect at 6 o'clock the following morning.

On November 27, the disease having been found in Carroll County, Md., just over the Pennsylvania border, a quarantine was placed on the State of Maryland. The operations in Michigan and Maryland are being conducted on the same cooperative basis with the State authorities as in the other States.

It now seems clear that the present outbreak had its origin near Detroit and that the infection in the other States came from that source. The Michigan cases were of longer standing than those found elsewhere, and the Department inspectors in tracing the movement of animals which appeared to have spread the contagion were able in most cases to connect them with the Wayne County outbreak.

While it will not be surprising if a few additional diseased herds are found in the localities where the contagion is known to exist, it is hoped that all centers of infection have at last been located and that there will be no further extension of the infected territory. After all known affected herds have been slaughtered and buried and the premises disinfected, it will be necessary to make a careful and thorough inspection from farm to farm in the infected region in order to detect any contagion that may possibly remain. With the combined efforts of the State and Federal authorities there is every reason to believe that the disease will be eradicated within a reasonable time.

The expense of this work will be heavy, and I shall have to ask Congress to make an appropriation sufficient to cover it. For the present the expenses are being paid from the regular appropriation for general expenses of the Bureau of Animal Industry, but this appropriation is not large enough to stand the drain which is being made upon it without seriously affecting the regular work of the Bureau during the remaining portion of the fiscal year.

As foot-and-mouth disease is strictly a contagious disease and has not been known to exist in the United States since 1903 until the present outbreak, it is supposed that the infection was introduced in some manner from abroad, though in just what manner the Department has not yet been able to determine. In view of our strict quarantine on imported animals and the fact that susceptible animals are not allowed to be imported at all from countries where this disease is known to exist, it does not seem possible that the contagion could have been brought in with live animals. It seems more probable that it was introduced with some material, such as straw, or with merchandise, or on the clothing, or with the effects of immigrants, or with biological products.

The Secretary of Agriculture already has power under existing legislation to enforce measures to prevent the introduction of contagious diseases from abroad so far as they are likely to be brought in with imported animals or with hay, straw, forage, or similar material, or meats, hides, or other animal products, from infected countries. No authority is given, however, to prevent the introduction of destructive animal diseases by the importation of virus or cultures of organisms causing such diseases, and I recommend that Congress enact a law which will empower the Secretary of Agriculture to guard against this danger. Such a law should prohibit the importation, except with the permission of the Secretary of Agriculture, of any virus that may be infectious for domestic animals. With this authority the Department could supervise such importations in such a way as to prevent the introduction of contagion by careless and irresponsible persons, while not interfering with any proper scientific work by responsible persons.

THE MEAT INSPECTION.

This was the second year of operation under the new meat-inspection law, and the experience gained has been productive of improvement in the methods of carrying on the work, while the regulations issued have been based on the best scientific knowledge and judgment available. There were engaged in this branch of the service at the close of the fiscal year 2,203 persons, of whom 616 were veterinary graduates. This force exercised a strict supervision over the slaughtering and packing operations at 787 establishments in 211 cities and towns. Compared with the previous year this is a gain of 79 establishments and 25 cities and towns.

As an example of the rigor of the inspection it may be stated that inspection was withdrawn from 8 establishments during the year because of violations of the regulations.

The present inspection deals not only with the health of the animals slaughtered for meat, but also with the sanitary conditions of preparation and honesty of labeling. The veterinary inspection before and at the time of slaughter is supplemented by subsequent examinations of the product, a laboratory inspection to determine the bacteriological and chemical conditions, and careful supervision of all of the various processes of preparing, curing, canning, etc. The thoroughness of the work has had the much-desired effect of greatly improving the sanitary condition of slaughterhouses and packing plants and of maintaining confidence in the wholesomeness of the products.

During the past year 53,996,511 animals were inspected before slaughter. Of this number 34,980,571 were hogs, 9,778,189 were sheep, 7,198,224 were cattle, 1,993,461 were calves, and 46,066 were goats. The animals inspected at slaughter numbered 53,973,337, an increase of 6 per cent over the previous year. Of these, 175,126 carcasses and 704,666 parts were condemned, 108,519 carcasses were passed for lard and tallow, and 53,689,692 passed for food. Tuberculosis was the cause of condemnation of about three-fourths of the cattle carcasses and about two-thirds of the hog carcasses that were condemned, and the majority of the other condemned hogs were affected with hog cholera and swine plague.

During the year the Government inspectors passed on nearly six billion pounds of meat-food products processed under their supervision.

There were condemned on reinspection during the year 43,344,206 pounds of meat products which had become sour, tainted, putrid, unclean, or, in the case of fats, rancid, since inspection at slaughter.

There was an increase of 13.8 per cent in the quantity of meats and products certified for export as compared with the previous year. Certificates to the number of 122,295 were issued, covering 1,545,761,808 pounds.

NEED OF STATE AND MUNICIPAL INSPECTION.

The Federal law has no power over products prepared and consumed within the limits of a State, and a large amount of the meat supply—almost one-half the entire slaughter of the country—comes within this class. The Department has found that the worst sanitary conditions exist at many abattoirs where such meats are produced. It is only natural that suspicious and diseased live stock, such as would fail to pass the Government inspection, find their way into these small establishments, to be thereafter sold and consumed within the State. The Department has, moreover, frequently found preservatives in meats prepared by local butchers. It is therefore very important that State and city health authorities should provide adequate protection to their people by inaugurating a system of abattoir inspection that will do away with the evils mentioned. Unfortunately but very few States have as yet realized the importance of this matter. It should be emphasized also in this connection that a mere examination of meat exposed for sale is insufficient. The only way in which consumers can be protected against diseased meats is by competent veterinary inspection of the carcasses at the time of slaughter, and this is a class of inspection that is very seldom found aside from the Federal inspection.

INSPECTION OF EXPORT ANIMALS.

The routine work of the Bureau of Animal Industry includes the inspection of animals for export and of the vessels carrying them. During the year 638 inspections were made of vessels in order to see that the fittings, equipment, ventilation, feed, water, attendants, etc., complied with the regulations.

Our very large trade in live cattle with Great Britain is well known. This, together with other foreign consignments, made a total of 448,163 animals inspected for export, and as some were inspected more than once there were 757,890 inspections made. Of the animals sent to Great Britain 381,684 were again inspected on arrival at British ports by Bureau inspectors stationed there, and the losses in transit were less than one-fourth of 1 per cent.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

A very necessary part of the work in controlling contagious diseases of live stock is the rigid inspection of all foreign animals at the ports of entry. In addition to the inspection a quarantine is imposed upon animals from all parts of the world except North America. During the fiscal year 250,890 imported animals were inspected, and of these 1,494 were quarantined.

CONTROL OF CONTAGIOUS DISEASES OF ANIMALS.

TEXAS FEVER.

Gratifying progress has been made in eradicating the southern cattle tick, which spreads the infection of Texas fever and constitutes a heavy burden to the section involved. Since the beginning of this work less than three years ago nearly 64,000 square miles of territory have been freed from this troublesome and costly pest. The work is being done in cooperation with the authorities of the States concerned. There is no question as to the ultimate success of this great undertaking provided the assistance of the States and of the cattle owners themselves is forthcoming. As a result of this work 40,798 square miles were released from quarantine during the fiscal year. This territory was located in California, North Carolina, Tennessee, Virginia, Arkansas, Oklahoma, and Texas. Besides these States active work was carried on in Alabama, Georgia, Louisiana, Mississippi, Missouri, and South Carolina. In connection with this work 2,271,436 cattle were inspected during the year.

SCABIES OF SHEEP AND CATTLE.

Very effective work has been done toward eradicating the diseases wn as "scabies of sheep and cattle." During the year there have released from quarantine on account of sheep scab the States of

Idaho and Wyoming, and since the close of the fiscal year an order has been issued releasing Kansas and Nebraska and portions of North Dakota and South Dakota. There were released from the quarantine for scabies in cattle 4 counties in Kansas, 57 counties in Nebraska, and portions of North Dakota and Colorado. The number of inspections of sheep was 59,471,141, and the dippings 17,589,578. Of cattle there were 16,920,100 inspections and 1,527,280 dippings.

TUBERCULOSIS.

The question of tuberculosis in animals, especially in dairy cattle, whereby human beings are liable to be infected through the products, has for some time been an acute one. Statistics show that the disease is on the increase, and it is therefore imperative that efforts be made to cope with this great evil. A conservative estimate was recently made by the Chief of the Bureau of Animal Industry, based on the meat inspection and the records of the tuberculin test, which shows the percentages of our animals affected as follows: Beef cattle, 1 per cent; hogs, 2 per cent; dairy cattle, 10 per cent. The financial loss to our stockmen and dairymen was estimated to be fully $14,000,000 per annum.

Tuberculosis can be eradicated from our animals only by means of systematic work of the Federal and State authorities in cooperation. Much can be done in the way of tracing the centers of the disease by means of our meat-inspection service. This is proved by what was accomplished during the past year in cooperation with the States of Nebraska and Wisconsin. When animals from these States were found by our meat inspectors to be tuberculous, the State authorities were so informed, and in the case of Nebraska upon tracing the animals back to the farms it was discovered in every instance that there was tuberculosis among the stock that remained. In order to make this feature of the work thorough, the various States should require shippers to tag their live stock sent for slaughter, especially cows, in order that the centers of the disease may be located and the authorities be enabled to stamp out the infection at its source.

In order to discover the disease, the tuberculin test should be systematically applied. The safest way of disposing of affected animals is to kill them, but in order to reduce the financial loss they should be slaughtered at abattoirs having Federal or other competent veterinary inspection. By this means many of the slightly affected carcasses could be safely utilized for food and thus made to yield their meat value. Especially valuable animals might be kept for breeding purposes under the Bang system of segregation.

Perhaps the greatest obstacle to the eradication of tuberculosis from our herds is the expense of the work and the payment of compensation to owners for the slaughter of their diseased animals. In such work that is largely for the public good it seems only just that the Government and the States should provide indemnity for at least a part of the loss. The benefits of eradication would unquestionably justify the expense, and when our herds have once been freed from tuberculosis it should be comparatively easy to keep them in that condition.

Work done at the experiment station of the Bureau of Animal Industry has shown that cows, seemingly in good health but which had reacted to the tuberculin test, were expelling myriads of tubercle bacilli in their feces. In ordinary dairy practice particles of this soil get into the milk, and thus two of the commonest articles of food —milk and butter—become contaminated. Analysis of market milk supplied to the city of Washington disclosed that fully 1 sample in 20 was infected with tubercle bacilli, and experimental work with butter showed that the germs will remain alive and virulent in the ordinary salted kind for one hundred and sixty days, or close upon six months.

HOG CHOLERA VACCINE.

At last the problem of discovering a successful method of preventing hog cholera seems to have been solved by the Bureau of Animal Industry. The vaccine or serum prepared according to the methods of Dr. M. Dorset, chief of the Biochemic Division of that Bureau, has been further tested in a practical way during the year, not only by the Department, but by some of the State experiment stations, and its efficiency as a preventive measure has been amply demonstrated. The Bureau has carried on field tests during the year on 50 different farms and has treated approximately 2,000 hogs, with the following results: In herds which had not been exposed prior to treatment, but in which hog cholera appeared subsequent to treatment, all of the vaccinated hogs remained well, while more than 64 per cent of the unvaccinated hogs, which were otherwise kept under the same conditions as "checks," died. In the herds which had been exposed before treatment but which were apparently well when vaccinated, only 4½ per cent of the treated hogs died, while approximately 90 per cent of the checks were lost. In the herds where the disease existed at the time of treatment only 13 per cent of the treated animals were lost, while 74 per cent of the checks died.

In a series of careful tests carried on by Dr. J. W. Connaway at the Missouri experiment station with serum prepared by the Department method the efficacy of the treatment was confirmed, and in a report of this work he said: "The results of these tests are so satisfactory as to leave in every mind no doubt as to the great practical value of this method of preventing hog cholera."

Thirty-seven herds were treated in Michigan under the direction of the State experiment station, and in nearly every case the disease had developed before treatment was begun. Out of 1,819 hogs treated, only 226 were lost.

The director of the North Dakota experiment station reports that when the disease recently appeared in the station herd the Department method of treatment was promptly applied, with the result that not a single animal died. As a further test the vaccinated animals were subsequently exposed to diseased hogs, but none contracted the disease.

The success which has attended the use of this treatment has been such as to warrant the use of the vaccine as an agent for combating the disease throughout the country. To prepare the vaccine on such a large scale, however, is beyond the power of this Department, and steps have been taken to interest the various States in the preparation of the serum. In accordance with this plan conferences of State veterinarians have been held at the Bureau experimental farm at Ames, Iowa, where opportunities have been given them to observe and learn the methods of producing and applying the serum. Already a number of State experiment stations are preparing and distributing the vaccine, some of them making a charge to cover the cost, and it is expected that other States will soon make the necessary provision for such work.

RABIES.

The presence of rabies, or hydrophobia, in dogs is still a menace to our people, and its disseminator, the rabid dog, is all too often allowed to roam at large and unmuzzled. The situation in the neighborhood of the National capital last spring became so alarming that the Commissioners of the District of Columbia were prevailed upon to issue a dog-muzzling order. While the prevalence of the disease has been diminished to some extent, the muzzling order has not been well enforced, and cases of rabies continue to occur.

The pathological laboratory of the Bureau of Animal Industry has continued to examine all animals sent there suspected of having rabies. During the fiscal year 117 such animals were examined and 82 of them were found to have been affected with the disease. The great majority of these came from Washington, D. C.

A case of rabies that occurred in a horse at the Bureau experiment station is of special interest. The horse was bitten by a dog which was found to have been affected with rabies. The horse, however, did not develop the disease until one hundred and thirteen days, or about three and one-half months, after it was bitten. It fractured one of its hind legs during a violent paroxysm of acute rabies and was consequently destroyed.

INVESTIGATION OF OTHER DISEASES.

Scientific investigations of various animal diseases and parasites have been carried on. The study of swamp fever of horses, in cooperation with the Minnesota experiment station, has continued with promising results, but has not been completed. Two animal diseases which have only recently been recognized in this country—epizootic lymphangitis of horses and chronic bacterial dysentery of cattle—are also being studied.

The vitality of the typhoid-fever bacillus in butter and milk has been investigated, and it has been shown that this organism will remain virulent in butter for about five months and in milk for a period far in excess of the time that it is ordinarily kept.

The experiments in connection with roundworms of sheep during the past year have chiefly concerned the problem of keeping lambs free from infection with these parasites. Should this work be as successful as anticipated it is planned to carry out practical trials under farm conditions during the coming year.

Studies of white diarrhea in chicks have thrown important light on a disease which has caused heavy losses, and the knowledge gained will enable poultrymen to combat it with more success.

THE INTERNATIONAL CONGRESS ON TUBERCULOSIS.

The Bureau took an important part in the recent International Congress on Tuberculosis. It provided an exhibit of pathological specimens, and several members of its staff presented papers and took part in the arrangements and proceedings.

BLACKLEG VACCINE, TUBERCULIN, AND MALLEIN.

The Bureau has continued the preparation and distribution of vaccine to prevent blackleg in cattle. About 1,200,000 doses were distributed to stock raisers during the fiscal year, and reports indicate that the vaccine continues to be highly effective.

Tuberculin, for the diagnosis of tuberculosis, and mallein, for the diagnosis of glanders, are supplied to official veterinarians and health officers. During the year 213,015 doses of tuberculin and 52,556 doses of mallein were prepared and sent out.

LIVE STOCK IN PORTO RICO.

An investigation of the diseases and conditions of live stock in Porto Rico was undertaken during the past year. The majority of the island cattle carry an admixture of zebu blood as the result of the introduction of a number of zebu bulls in 1858. They are noted for superior size and working ability. Cattle all over the island are infested with ticks. The principal diseases are blackleg among cattle and glanders and epizootic lymphangitis among horses and ponies. There is no mange and no tuberculosis.

ANIMAL HUSBANDRY WORK.

HORSE BREEDING.

The work in breeding American carriage horses, carried on in cooperation with the Colorado experiment station, continues with good results, and some very promising animals have been produced. During the fiscal year 4 Kentucky mares were added to the stud, which at the close of the year comprised 63 animals.

The stallion General Gates, two mares, and a filly were bought for the Vermont work in breeding Morgan horses, and the farm at Middlebury donated by Mr. Joseph Battell has been improved. Horses used in this work were exhibited at two fairs in Vermont and attracted very favorable attention. The Morgan stud consisted of 25 animals at the close of the fiscal year.

An experiment is also in progress in Iowa, in cooperation with the Iowa experiment station, to evolve a breed of American draft horses. The animals in this stud at present are imported Clydesdales and Shires. The horses have done well since their arrival in the summer of 1907, but no foals were obtained during the fiscal year.

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The classification proposed for American carriage horses by a committee representing the Department and certain breeders' associations was adopted in whole or in part by twelve fairs for the season of 1908, and a number of creditable exhibits were made in these classes.

EXPERIMENTS IN BEEF PRODUCTION.

Two series of experiments in feeding cattle for beef production have been carried on in cooperation with the Missouri experiment station, with a view to testing the economy of certain rations and supplementing the pasture with different nitrogenous feeds.

Similar experiments are also being continued in Alabama to study this subject under southern conditions.

POULTRY INVESTIGATIONS.

The cooperative poultry work at the Maine Agricultural Experiment Station, begun in 1904, has been continued and some of the results are being prepared for publication. Other experiments in feeding poultry by different methods are in progress at the Bureau experiment station, but have not progressed far enough to yield definite results.

During the year a study was undertaken of the conditions surrounding the production, transportation, and marketing of eggs, with a view to determining some of the causes of deterioration in quality and consequent loss in value. It is believed that information is being obtained which will be of much value in pointing out means for improving the quality of the southern and western eggs shipped to the East and for saving a considerable unnecessary loss to the producers.

WORK RELATING TO THE DAIRY INDUSTRY.

SOUTHERN DAIRYING.

The educational work for the development of dairying in the South has been continued with excellent practical results. Some of the drawbacks to the southern dairy industry are the lack of a sufficient number of good cows, the lack of home-grown feed, and the lack of suitable buildings. Efforts are being made to assist the southern farmers along all these lines. In order to determine which cows are profitable and which unprofitable, the farmers are encouraged to keep records of their herds. As an example of what is being accomplished in this respect, it may be stated that twelve months' records of 719 cows in small herds located in various parts of the South show an average profit per cow of $32.61; the best cow showed a profit of $94.40, and the poorest cow a loss of $3.73. The average profit of the best 10 cows was $79.24, while the poorest 10 cows made an average loss of 1 cent. It often happens that what are regarded as the best cows show, when tested, much poorer results than others in the herd, and it is by keeping records and compiling such information as the foregoing that the farmer is enabled to eliminate the poorer animals and to bring up the average production of his herd to a profitable point.

The Bureau has also assisted the southern farmers by furnishing plans for and supervising the erection of 45 silos, 28 barns, and 5 dairy houses during the fiscal year, and a larger number of such buildings are projected for the coming year.

It is the purpose of the Department to carry on this educational work in the South in cooperation with the state authorities and institutions so far as possible, and to prevail upon the States to take up and continue the work so that the Department may, after getting it well started and showing its benefits, withdraw and devote its attention to other fields. Several of the States have provided men and appropriations for such work, and as the good results become more apparent the interest is increased.

DAIRY PRODUCTS INVESTIGATIONS.

The investigations to determine the cause of the so-called fishy flavor of butter are not yet complete, but have given important information which it is believed will assist butter makers in overcoming this trouble. Acid appears to be in some measure responsible for this flavor, but certain results have indicated that the controlling factor is the treatment of the butter in the churn.

Different lines of experiments in making the Cheddar, Swiss, Camembert, and Roquefort types of cheese have been continued, and some of the results have been published. This work has a practical bearing in assisting American cheese makers to produce some of the kinds of cheese that are imported in large quantities.

MARKET MILK INVESTIGATIONS.

Considerable work has been done during the year for the improvement of milk supplies. This has usually been done by giving assistance to city boards of health and to dairy farmers. One hundred and forty cities have been given more or less assistance during the year and a number of these have made marked improvement in their milk supplies. The score card has proved to be an important agency in improving the sanitary condition of the dairies. By means of this card the specific features are rated on a definite scale, and it is much easier for the health authorities and the dairymen to determine just what conditions need improvement. Two hundred and six dairies with 8,527 cows were inspected and scored during the year, the average score being 51.05 on a scale of 100. Reports have been received on about 10,000 dairies that were rated by officials and persons outside of the Department, and the average score of these was 52.05. It appears that there is a greater need for improvement in methods than for better equipment.

DAIRY MANUFACTURES.

The Bureau has also continued its work of inspecting butter as received at 3 of the principal markets and reporting its condition to the creamery, the purchaser, and the dairy and food department of the State where the creamery is located. By this means many of the creameries have been enabled to improve materially the quality of their product. It has been found, however, that much of the poor quality of butter is due to the fact that some of the cream is very old when received by the creamery and it is impossible to make good butter from such material. This condition is due partly to the competition between the local and the "centralizer" creameries and partly to the way the cream is handled on the farm. Since the introduction of the hand separator the farmer has found that he can keep the cream longer on the farm and take less care of it and still find a market for it, and he is taking advantage of this.

An increasing number of creameries are regularly reporting to the Bureau, and with the information received it is sending out a monthly circular letter in addition to other correspondence, giving advice as to remedying losses and other unfavorable conditions. As an example of the practical benefit of this work reports of creameries in Minnesota, Iowa, and Wisconsin, where the work has been in progress for two years, show that within the past year these creameries have increased their average overrun to an extent which increased their returns by about $130,000.

RENOVATED BUTTER INSPECTION.

In the enforcement of the law regarding the inspection of renovated butter the Bureau has exercised supervision over 46 factories and has inspected their product and the material entering into it. There was produced during the fiscal year 50,658,158 pounds of renovated butter, a decrease of 12,261,840 pounds.

BUREAU OF PLANT INDUSTRY.

During the past year the work of the Bureau of Plant Industry has been pushed forward vigorously. Its research work in the laboratory has resulted in a number of important discoveries, its experimental field work has developed new methods of applying fundamental principles for the benefit of agriculture, and its efforts in the line of practical demonstrations and cooperation with farmers, fruit growers, and others have brought the Department into close contact with the people.

SEEKING NEW CROPS FOR THE AMERICAN FARMER.

EXPLORATIONS IN CHINA, KOREA, AND SIBERIA.—In pursuance of a general policy, energetic efforts have been put forward by the Bureau the past year in the matter of securing new crops and establishing new agricultural industries. During the year more than 2,000 carefully selected, newly introduced plants have been brought in and placed in the hands of thousands of private experimenters and official plant breeders, and others attached to State and other experiment stations of the country. We are still sending abroad many millions of dollars for products which may well be grown at home, and in carrying out the general plan of securing data bearing upon the production of these crops and the crops themselves, the explorations and other work outlined below were carried on. One of the agricultural explorers, Mr. Frank N. Meyer, who for the past three years has been in China and Siberia, returned to this country in July after a continuous search during that time for new crops. This is one of the most extensive pieces of agricultural exploration work which the Department has undertaken. In addition to the many hundreds of new plants which Mr. Meyer secured he has brought back a fund of information which will be valuable in connection with our various lines of work here. Mr. Meyer devoted considerable attention to the

Chinese methods of growing crops under dry-land conditions, and the information he secured regarding dry-land farming practices, horticultural methods, market-gardening operations, and the vast forestry practices of the Chinese Empire reveals in a remarkable way the wonderful variety of plants grown by the Chinese and the great similarity of the climate of eastern Asia to that of the United States.

The explorations made by Mr. Meyer in certain of the Chinese provinces reveal the presence of an extensive orchard industry which is worthy of serious consideration for our dry southwestern regions, the Chinese regions and our southwestern country being very similar in climate and soil. Mr. Meyer found extensive orchards of what is known as the "Chinese date," a drought-resistant fruit tree of which the Chinese have developed hundreds of varieties and of which the dried fruits form a most palatable and valuable fruit product with which this country is entirely unfamiliar. He secured numerous varieties of this date, among which was a seedless sort which is now being propagated for distribution in the Southwest.

A number of varieties of new seedless persimmons have been introduced. These are quite different in form and presumably hardier than any of the Japanese persimmons which are being grown on a commercial scale through the South. One variety has already been fruited here, and some of the fruit attained a diameter of 4 inches. It is perfectly seedless, not astringent as the ordinary Japanese forms are when hard, does not fall off readily, and promises to be an excellent shipper.

A large collection of wild and cultivated pears was secured; also varieties of wild walnuts and chestnuts. There were also secured wood for the propagation of the famous Feitcheng peach, specimens of which weigh over a pound, as well as new apricots and wild apples which it is believed will be of particular value to the breeders of the Mississippi Valley, who are developing hardy forms of these plants. A great many new ornamentals have also been obtained, such as new spruces, new elms, and new pines, these coming from the bleak, arid regions of the Wutaishan, and in all probability being adapted to sections of this country where ornamentals of this nature have not hitherto been grown. A special effort was made by Mr. Meyer to secure new ornamentals suitable for parks and public grounds. Many of these things have been brought in and are now being tested and grown by the various cooperators of the Department.

Explorations in central Asia.—Recognizing that the Great Plains region of this country is in much need of assistance, explorations were inaugurated the past year with a view to securing forage and other crops for this vast section of the country. Early in the summer Prof. N. E. Hansen, of the South Dakota experiment station, was sent out to make a thorough exploration and investigate the probable value for the United States of certain promising alfalfas, clovers, grasses, and other crops of southern, central, and western Siberia. Professor Hansen took with him early in July three Russian assistants and proceeded to the regions around Omsk for the purpose of arranging to collect large quantities of seed of three yellow-flowered alfalfas, which are known to be cold-resistant, strong-growing, and erect types and are, furthermore, likely to be of great value for hay as well as pasture in the northwestern sections of this country. The latest information from Professor Hansen indicates that he has located large areas of the western Siberian alfalfas and has arranged for considerable quantities of seed. In a letter dated October 24, from Omsk, Professor Hansen reported the finding of good seed of one of the three yellow-flowered Siberian alfalfas which he started out to secure. This is the same plant found by Professor Hansen in 1906, and he now states that it is a fine, erect-growing type, with large leaves and large, flat pods. Both the Mongolian and flat-pod alfalfas are now coming to America for the first time, and Professor Hansen deems them very promising, owing to their extreme hardiness and their strong, erect habit, which will make mowing easy.

Professor Hansen also reports the finding of the Siberian lupine clover, which extends to 70° north latitude, which is also a fine, erect plant well liked by stock; also two wild red clovers, which will no doubt be more valuable for the North than our present stock of southern origin, as he got them where the mercury freezes in winter. Some fine Siberian vetches have also been secured. Owing to the nature of this work, it will not be practicable to secure large quantities of any of the seeds. Commercial seed houses in this region are unknown, and almost the only way of securing the valuable things indicated is through hand gathering and hand picking by peasants and others hired for the purpose.

This work of Professor Hansen is carried on in a climate very similar to that of the northern Great Plains region, and it is hoped that the new introductions will add materially to the wealth of the northwestern farms and pastures. The growing need for these crops is manifested in sections where grain has been the mainstay of the farmers. To successfully continue the growing of grain, rotations are essential. Legumes, therefore, such as clovers and alfalfas, which will fit into the conditions of this region will be of great value, not only in giving the farmers wider opportunity for diversification, but will also be valuable in building up and maintaining the fertility of the land.

New forage plant for the Southwest.—Shaftal, a new and promising clover, secured last year by the Department from the valleys of the Himalaya Mountains, near the border of India, has proved an exceedingly good producer in the hottest parts of the Southwest. It will doubtless prove valuable in rotations in this section, and with the advent of Egyptian cotton culture its usefulness will probably be greatly increased. It has grown most successfully in the hottest irrigated valleys of the Southwest. Prof. N. E. Hansen, whose attention was called to this promising plant before he left on the trip already referred to, reports that he has found it in considerable quantity and will be able to forward seed for experimental purposes.

BAMBOO INTRODUCTIONS.—The unusual and important uses to which the bamboo is put by our neighbors in the Orient and the discovery by means of various importations that this useful plant can be grown along the Gulf States and in California have induced us to engage an expert in Japan, who has made purchases of several thousand bamboo plants, which he is now shipping to this country. These will form the nuclei of small plantations established in the Southwest, where the climate is suited for the crop. If it is found that the bamboo may be successfully grown on these plantations its cultivation will be extended, with a view to getting the wood introduced into various channels of trade here.

EXPLORATIONS IN SWEDEN, DENMARK, AND GERMANY.—In order to ascertain why American barleys are considered by experts inferior to the best European-grown barley, Dr. Albert Mann, an expert of the Bureau, was sent as an explorer to Sweden, Denmark, England, Germany, and Austria to make a thorough study of the methods employed by our European neighbors in the improvement of one of their most important grain crops. Doctor Mann has secured data regarding the latest processes used by European workers in the breeding and selection of barley for special purposes, and in particular the Svalöf system of collecting and classifying new varieties of this and other grains, and he has been successful in perfecting methods for rapidly determining the value of barleys, methods which will be very useful in the continuation of the important work on the improvement of this crop now under way.

MATTING PLANTS FOR FLOOR MATTINGS.—As the result of previous explorations in the Orient and elsewhere, and as announced in previous reports, the Department has put itself in possession of a collection of matting plants of the best varieties, and the present season has seen the production of matting straw which has been pronounced by experts equal in quality to that grown in the Orient. The first piece of home-woven straw matting has been produced here from straw grown by the American farmer, and the experts are now at work devising cheaper methods of planting, harvesting, splitting, and curing these matting plants, large quantities of which we import every year. While this work is progressing satisfactorily, attention should be called to the fact that in the transplanting of any crop or industry from one country or region to another unexpected difficulties may arise. The cheap labor of the Orient can not be utilized here, and in consequence many of these new industries require special machinery for handling the crop. This is the case with matting. These new problems are now under investigation, and it is confidently believed that the industry can and will be established here.

Reed matting lath.—As an outgrowth of investigations in the manufacture of floor matting, our experts have discovered a new and probably profitable use for the common reed which grows so abundantly along the waterways of the United States. In Sweden, Denmark, and Germany these reeds are used in place of laths, and the loom manufacturers of New England have been encouraged to work out a feasible machine for the weaving of these reeds into matting. They have been so successful that several of the best builders in the country pronounce the product of great promise as a substitute for the ordinary lath. There are thousands of acres of what are now considered practically waste land that might be devoted to the production of reeds suitable for the manufacture of the lath matting. This phase of the problem is being investigated by the Bureau.

Egyptian cotton in the Southwest.—The United States imports about $15,000,000 worth of Egyptian cotton annually for the manufacture of special fabrics. The growing, grading, and handling of this crop have been so perfected that the product is exceedingly uniform, and the fiber being of a very high quality, fancy prices are always received for it. For a number of years the Department has been endeavoring to establish this crop in the United States. Several years ago some work was undertaken in the Southwest, notably at Yuma, in cooperation with the Reclamation Service on one of their projects. This work has already progressed sufficiently to warrant us in saying that there is a great promise of establishing an important cotton industry in the region mentioned.

The past year a total of about 40 acres was planted to Egyptian cotton at various localities in southern Arizona, seed of the acclimatized strain that has been grown for six years in the Southwest being used. The indications point to an average yield of 1 to 1½ bales per acre wherever the planting was done in good season and the cotton received reasonable care. A good commercial fiber was obtained, satisfactory in strength and fineness but not in the matter of length and color. It is planned to sell the product at the highest price obtainable in order to ascertain approximately what profit can reasonably be expected by growers of Egyptian cotton in the Southwest. The marked interest in these experiments evinced by a number of

American manufacturers of Egyptian cotton makes it reasonable to expect that the Arizona-grown fiber can be marketed advantageously.

The peculiar climatic and soil conditions in this region have developed a number of unexpected problems which will necessitate careful laboratory and field work for settlement. It is found, for example, that for reasons not yet fully explained cottons hybridize naturally. In view of the fact that one of the essentials in establishing this industry is the securing of a uniform product, there is some careful work ahead in the matter of determining the causes of the variations noted, and fixing by practical methods the types which the market demands and for which it is ready to pay the highest price.

New tropical and semitropical fruits.—American fruit growers living in the subtropical areas of the United States have fruited this year an unusual number of the fine East Indian mangoes which have been imported from time to time by the Department and distributed among them, and with the living material now on hand it should be feasible to go ahead and establish important tropical fruit industries. Many of these valuable mangoes have been placed in Florida, and are being successfully fruited there.

The growing of Dutch bulbs in America.—The United States imports bulbs each year to the value of $300,000 to $400,000. A number of efforts to grow these bulbs in the United States have been made. Certain sections of the State of Washington seem to be well fitted for this sort of work. Various private parties have inaugurated the work, but for one reason or another they have not been entirely successful. The failure so far to place commercial bulbs on the market is not believed to be due to the difficulty of production so much as to the fact that other horticultural industries in this comparatively new region have offered more opportunities for ready returns. Transportation conditions and freight rates have also militated to a certain extent against the industry. The people of Bellingham, Wash., however, are very much interested in the industry, and have cooperated with the Department in furnishing land, buildings, water, etc., to carry on practical demonstration work for a number of years in the growing of the crop. It is planned to grow bulbs now used by the Department and bought abroad, and by this means aid in demonstrating the feasibility of growing the crop in sufficient quantity for commercial purposes.

EXTENSION OF THE CEREAL WORK.

Durum wheat.—The total production of durum wheat for 1907 appears to have been somewhere between 45,000,000 and 50,000,000 bushels, a little larger than that of the previous year. Of the total crop, over 25,000,000 bushels were exported. For 1908 the crop of durum wheat will probably be something over 50,000,000 bushels.

There is already a large export of the 1908 crop, a considerable quantity having been shipped to Russia, from which country our own seed was originally obtained. It is evident that the demand will again exceed the supply before the winter is over.

In connection with durum wheat, the operations of the year have witnessed some new enterprises with respect to utilization of the crop. One of the largest milling firms in the country has used one mill entirely for grinding durum flour, while a very large milling concern in another city has launched into an extensive production of durum wheat semolina for macaroni manufacture. Extensive tests have also been made during the year by prominent bakers in this country and Europe in the use of durum wheat flour for bread, all of which have been fairly successful. Scotch bakers are now importing the wheat for bread making. In an agricultural way the chief line of investigation during the year has been a thorough comparison of the best varieties of this wheat. A number of these are being grown and are now being developed as perfectly pure strains. This line of work is highly important, as the original introductions were unquestionably mixed types. It will be the effort as soon as possible to get into the hands of farmers pure seed of the variety that proves best under local conditions of soil and climate.

EXTENSION OF THE WINTER-GRAIN AREA.—With a view of extending the area of winter-grain production in the Northern and Western States the Kharkof strain of the Crimean or Turkey hard winter wheat group has been still more widely grown during the past year, not only in Kansas and Nebraska but in Colorado, Wyoming, South Dakota, Iowa, and portions of North Dakota, Minnesota, and Wisconsin. In all trials of the various winter wheats on State experimental farms in Wisconsin the Kharkof did much better than other varieties, which included two or three other hardy strains from Russia. An important conclusion derived from several years' experiments with this wheat is that it is particularly hardy in cold districts which are also dry—that is, it is rather remarkable in its resistance to a combination of drought and cold.

Important work has been carried on during the year in the improvement of oats and the testing of new types from foreign countries. Special efforts have been put forward to push the production of winter oats through the South. Special efforts, furthermore, have been made to extend the growth of winter barley as a grain crop, particularly through the South and West. In addition to the region of Kansas and adjacent portions of Missouri, Nebraska, and Oklahoma, winter barley has now been tried at a number of points in other States, particularly Indiana, Illinois, and Ohio, and has been unusually successful. The yield per acre continues to be much larger than that of spring barley grown in the same locality.

Important results have been obtained in an effort to further extend the use of black winter emmer as a crop for stock feed on dry lands. A considerable amount of seed of this emmer has now been produced at various points, but not sufficient for general distribution.

Cereals for dry farming.—More attention than formerly is being given to the development of drought-resistant cereals. During the year work has been started at six different stations located in representative sections of the Great Plains and intermountain areas. Large numbers of varieties of grain are being tested at these stations for their hardiness and drought resistance. While only one year's results have been secured, many new varieties introduced have outyielded ordinary sorts from 20 to 50 per cent.

Improvement of Pacific coast wheats.—The Department has continued its cooperative work in California with a view to the improvement of the wheats of the State. It is highly important to secure more glutinous wheats for the Pacific coast regions, and this is the primary object of the work under way.

Grain sorghums.—Extensive experiments with grain sorghums are being conducted at different points in the Great Plains area. This work has an important bearing on the development of the agricultural resources of the region; and some of the results secured have been promising. Extra-early and dwarf strains of milo and kafir varieties and the recently introduced kowliangs from China have been produced and the area of profitable growth extended. Promising hybrids are being developed into improved varieties.

Extension of the rice work.—Important work has been carried on during the year in cooperation with the Louisiana experiment station at Crowley, La. A study has been made on this farm of the manner and time of opening of the rice flower, which will be of much value in aiding all future work in the cross-breeding of rice. A classification of the known varieties of rice has also been prepared, which will be of use in future investigations. Efforts are being made to extend the rice work through the adoption of better varieties, improved methods of growing crops, and the extension of the area into other regions, notably California and Arkansas.

PROGRESS OF FORAGE-CROP WORK.

During the year the important work of encouraging the production of forage crops throughout the country has been vigorously prosecuted. This work has for its primary object the encouragement of the production of forage crops of various kinds wherever it is possible to do so in connection with other systems of farming. A special effort has been put forward to push the production of leguminous forage crops in the South, to extend the field for alfalfa culture in the Middle West and East, and to secure and establish forage crops of various kinds, particularly legumes, for the colder Northwest and the dry sections of the Middle West and Southwest.

ALFALFA EXTENSION.—During the past three years an extensive series of cooperative experiments in growing alfalfa has been conducted with farmers in the States of Maryland, Delaware, Virginia, and North Carolina with a view to determining the possibilities of this crop. These cooperative experiments number over four hundred and have been undertaken in many instances with the help of State experiment stations. They have been made primarily to determine the governing factors in the growing of this important crop in the various sections. Some of these factors are now well established, and it is believed that the work done will be of great value in getting this important crop more extensively used throughout the region in question.

WINTER LEGUMES FOR THE COTTON BELT.—Much attention has been given during the past year toward encouraging the greater use of winter legumes. Experiments throughout the South have indicated satisfactory results. Numerous demonstration experiments have been undertaken with farmers in most of the Southern States. In the very numerous instances where failure with these legumes has heretofore been reported the difficulty is found to be due largely to lack of inoculation. Whatever be the factors involved the fact is clear that inoculation is very difficult to obtain in the South except when using soil from an old field of the particular legume planted. The results of the work thus far indicate that crimson clover is to be preferred on the sandy lands, while vetch does best on the heavier soils. Experiments further indicate that when once the land is thoroughly inoculated there is little difficulty in securing satisfactory stands both of vetch and crimson clover when sown in the cotton in late summer.

A NEW LEGUME FOR THE SOUTH.—In 1906 there was obtained from the Philippine Islands a new bean, *Mucuna lyoni*, related to the Florida velvet bean. Although this has been grown but two years, in comparison with the Florida velvet bean it is already demonstrated that it is much more prolific and somewhat earlier, at the same time being just as vigorous a grower. So markedly has its superiority shown itself as regards heavy seed production that many cooperators have not hesitated to predict that it will within a short time entirely supplant the Florida velvet bean. It is not unlikely that this variety will succeed farther north than does the Florida velvet bean, and it is certain that it will ripen its seed considerably farther north than that variety.

COLD-RESISTANT ALFALFAS.—Considerable work has been done during the year by the Bureau in the matter of securing alfalfas that are cold resistant. The important work of Professor Hansen in this field has already been pointed out. In addition, the Bureau has been engaged in investigations with a view to securing alfalfas that can be used by farmers of the Northwest, where the winters are cold and dry. The value of the Grimm alfalfa for this purpose has already been pointed out. This has been grown in Minnesota since 1857, and has proved quite hardy. The Grimm alfalfa was originally brought to Carver County in Minnesota, and the crop has been quite firmly established in this section and is being gradually extended to other regions, although the seed is somewhat difficult to secure.

The sand lucerns which have been secured give every indication of being perfectly hardy and will undoubtedly be of great value for this northwestern section. Commercial sand lucern seed may be obtained readily from Europe, but unfortunately it often contains much weed seed and is therefore objectionable. On this account the seed production of this hardy alfalfa is being fostered, especially in northern Montana, where the severity of the winters will largely preclude any accidental mixture with nonhardy varieties. In addition to the hardiness of this variety it has proved quite a drought resistant. The remarkable variability that it shows also makes it a most fruitful source for selection for increasing both seed yield and hay production.

TOBACCO INVESTIGATIONS AND EXPERIMENTS.

The tobacco work as outlined in previous reports has been continued during the year. This work has been carried on in the Connecticut Valley, Florida, Texas, Alabama, Kentucky, Tennessee, Ohio, New York, Maryland, and Virginia, the object being to secure improved types by methods of breeding and selection, and to fix these types and establish them, to demonstrate the best means of growing the crops in the various regions, to accomplish the wide distribution of seeds of improved types, to introduce rotation and diversification, to aid in maintaining the fertility of the land where tobacco is made a specialty, to study various diseases, and by work in the laboratory to solve important points concerning the questions of burn, aroma, etc. The work in the Connecticut Valley has placed the industry on a new basis, it having been conclusively demonstrated that the varieties originated are eminently adapted for culture under shade and in the open field. The culture of tobacco under shade in the Connecticut Valley has been put on a profitable basis by the growers through the use of the Hazlewood Cuban tobacco, an extremely uniform variety adapted for culture under shade in this valley, and the use of improved methods of culture, the result of experiments and experience.

Through improved methods of sterilization of tobacco seed beds some very destructive diseases have been eliminated. One of the most important discoveries of the year resulted in the control of the destructive root-rot in the tobacco fields in the Suffield and other districts of the Connecticut Valley. It has been found that an application of acid phosphate at the rate of 1,000 pounds per acre corrects the alkaline soil conditions in the diseased fields, and it has been proved in extensive field trials that this treatment remedies the abnormal soil conditions brought about by the continued use in large quantities of certain fertilizers and makes it possible to grow normal and profitable crops on the diseased soils.

Important work has been continued in the matter of securing cover crops for the tobacco fields during the winter. Several years ago hairy vetch was introduced into this section, and it has been demonstrated that this crop adds about $18 per acre of nitrogen to the soil, and its value, both as a fertilizer and for improving the humus condition and the physical condition of tobacco lands, is estimated to be worth at least $35 per acre.

In Florida fourteen tobacco breeding fields have been conducted with individual growers. These fields are located so as to secure variety in cultural conditions, soil, and other things. In Texas the work has been mainly in connection with pushing the work of growing wrappers and cigar fillers. Assistance has been furnished growers in the way of expert advice as to methods of culture, curing, and fermentation of the crop. About 75 acres of shaded tobacco and 250 acres of Cuban filler types have been grown in the State. In Alabama the work has been with cigar filler and wrapper tobacco. In Kentucky and Tennessee extensive breeding work and fertilizer tests have been continued with the various types grown there. Similar work has been carried on in Ohio and New York. In addition to the definite experimental work under way in the different tobacco sections the Department is cooperating with a large number of individual tobacco growers who have taken up the systematic improvement of established varieties of tobacco.

One of the important lines of tobacco work is in connection with the export and manufacturing tobacco districts in the States of Virginia, Maryland, and Kentucky. The general aim of this work is to secure data by experiments and investigations and to show by demonstrations how best to build up and restore the fertility of the rundown fields found on the average tobacco farm. Tobacco is a crop of comparatively high commercial value and responds profitably to the liberal use of commercial fertilizers when intelligently applied and adequately supplemented by humus crops. An extensive system of fertilizer experiments, which in some cases have now been going on for four years, has been conducted in a number of locations in the States named and on all varieties of soils, and these experiments indicate how readily tobacco soils known to produce about 800 pounds of tobacco to the acre can be improved so as to produce 1,400 to 1,600 pounds per acre and at a greatly increased net profit. At the same time the work has demonstrated the value of rotations and fertilizers in building up and maintaining the fertility of the land. Fine crops of 2½ to 5 tons of hay per acre have been grown in rotation with tobacco and other crops. This work is being done in cooperation with State experiment stations, all of which are contributing liberally in the matter of expenses involved.

WORK OF THE PLANT PATHOLOGISTS.

Important lines of work in plant pathology have been carried on during the year. Much of this work is necessarily conducted in the laboratories at Washington, but the practical demonstrations and experiments are carried on in the field. Studies have been continued on a variety of bacterial diseases of plants. A bulletin has been prepared and published dealing with the olive tubercle prevalent in California. A serious disease of tobacco, known as "wilt," prevalent in North Carolina and Florida, has been investigated, the causes determined, and results published. Some important studies of the crown-gall of cultivated plants have been carried on during the year. This disease is of bacterial origin. Such galls occur on a great variety of plants, and before the problem of restricting the distribution of crown-gall can be solved we must know whether or not these galls are of common origin. To this end many cross-inoculations have been made. Up to date it has been shown that the micro-organism cultivated from the crown-gall of the peach is able to produce tumors on peach, apple, daisy, and sugar beet. In the last eight or ten years there has been a great deal of investigation of this obscure trouble, and it is gratifying to know that we are at last getting results which promise not only to show the direct cause of the disease but to point the way to practical methods of treatment.

Orchard-fruit diseases.—Studies of orchard-fruit diseases have been continued along a number of lines. In California the Bureau has continued to give expert assistance to the California growers in combating pear blight. The California growers and the State and county horticultural commissioners and the State experiment station are cooperating with the Department in this work. Pear-blight during the past year or two has invaded the fine pear orchards of the Rogue River Valley in Oregon, and the Bureau pathologists were called there to assist in the effort to stamp out the disease or control it. Important work has been carried on during the year in connection with the little-peach disease and peach yellows, the winter injuries of fruit trees, the gumming fungus of the peach and other stone fruits growing in California and other Pacific Coast States, and certain injuries to apple and peach foliage as a result of spraying with Bordeaux mixture and other fungicides.

A NEW SULPHUR WASH.—One of the most important steps in recent years was the discovery made during the season that the self-boiled lime-sulphur wash is not injurious to peach foliage when properly made and will not produce russeting and other injurious effects on apples. Furthermore, it has been found to be about as effective as a fungicide as the standard Bordeaux mixture. Extensive experiments have been carried on during the present year on nearly all of our common fruit diseases which are preventable by spraying. The results have been corroborated and extended, bringing out the value of this excellent spray mixture and demonstrating its usefulness.

SPRAYING DEMONSTRATIONS.—An important line of work in field demonstrations in connection with orchard treatment was carried on in Missouri, Arkansas, Kansas, Nebraska, Illinois, and Georgia. This demonstration work has been very effective in bringing home to the orchardist the most successful methods of treating diseases. The peach and plum brown-rot, the apple scab, bitter-rot, blotch, and leaf-blight, and the cherry leaf-blight are some of the diseases that have been handled the past season over a wide extent of territory.

POTATO DISEASES.—Comprehensive studies of potato diseases are being conducted to solve the new problems constantly arising and to attack old problems from new view points. Late-blight, the principal source of loss in our great potato States, can be controlled by spraying, but there is much need for the introduction of disease-resistant varieties. All of the best European and American varieties have been tested for four years, largely in cooperation with the Vermont experiment station, and it has been learned that there are some very resistant potatoes, but not all of them are desirable in other respects. The production by breeding of new American varieties resistant to disease will be the final solution of this problem.

DISEASES OF TRUCK CROPS.—The great development of the trucking industry along the Atlantic and Gulf coasts has brought with it a host of new problems for investigation. The growers rely almost entirely on commercial fertilizers for the production of their crops, and some have used them exclusively and in excessive amounts until distinct nutrition diseases have appeared and caused much loss. The Bureau is studying these malnutrition problems and has already shown that by a suitable modification of the fertilizer formulas, together with the use of lime, stable manures, and green manures, the diseases may be prevented. Potato spraying—an established practice in Northern States—has not come into use in the trucking sections. The Department is adapting methods and practices to local conditions, to the end that better control of all potato diseases may be had. Similar work is being done with cucumbers, cantaloupes, and other truck crops grown extensively along the Atlantic coast.

DISEASE-RESISTANT COTTONS.—The increase and further improvement of the wilt-resistant Upland cottons mentioned in previous reports continue to receive attention. The distribution of several hundred bushels of seed has resulted in the general introduction of these varieties into infected districts. We now have under way selections designed to be adapted for boll-weevil conditions. Special attention is called to the desirability of practicing crop rotations for the control of root-knot in the South and to supply something to take the place of the ordinary cowpeas, which must be avoided in such rotations, and wilt-resistant and root-knot-resistant varieties have been developed.

IMPROVEMENT OF CROPS BY BREEDING AND SELECTION.

WORK ON CORN IMPROVEMENT.—Gratifying results have been secured during the past year in the breeding of improved strains of corn. The breeding work has been conducted so as to cover a wide range of territory, extending from the most Southern through the Central and into the most Northern States. As a result of the work the past three years a high-yielding strain of corn showing remarkable adaptability to dry-weather conditions has been developed in Texas. This strain has proved of value in Arizona and other parts of the Southwest.

The breeding of strains of corn for increased yield, greater uniformity, and adaptation to soil conditions in localities where grown has been continued at points in Tennessee, Virginia, Maryland, and Ohio. At all of these points the Department selections have shown their superiority to the strains commonly grown. In Virginia during the past year fields grown from one of these selections produced from 90 to 100 bushels per acre, which was about one and one-half times the average yield in the community where the crop was grown.

In Wisconsin the Department has developed a high-yielding early-maturing variety that produced last year during an unfavorable season 100 bushels to the acre.

Breeding experiments have been started the present year in California, Nevada, and Arizona to secure strains adapted to the peculiar conditions prevailing in those localities.

The work in the improvement of sweet corn has been continued, and several high-yielding strains of excellent quality have been developed as the result of work in New York, on the Arlington Experimental Farm in Virginia, and elsewhere.

SECURING NEW COTTONS BY BREEDING.—Owing to the fact that the Mexican cotton boll weevil has now invaded nearly all of the Upland long-staple section, which includes the valleys of the Mississippi and the Red rivers in Louisiana and Texas and the delta lands in Mississippi above Vicksburg, a special effort has been put forward in the matter of breeding better cottons for these weevil-infested sections. It appears evident from present experience that the fine varieties of staple cottons now used in all these regions will be practically useless when the weevil obtains a foothold. The Department has some crosses which have proved by two years' trial under weevil conditions in the Red River Valley at Shreveport, La., that they are adapted to this region.

For Texas the varieties which the Department has originated are grown in increasing acreage each year, and other new types of the very desirable native big-bolled strains are being distributed this year.

Other important cotton-breeding work has been carried on in Tennessee, South Carolina, and adjacent States.

FARMERS' COOPERATIVE BREEDING WORK.—With a view to bringing the results of the breeding investigations of the Department home to the farmer in such a way that he can adopt the practices which the Department has been perfecting, extensive cooperative work has been inaugurated in a number of Southern States. Cooperative breeding work with several types of cotton and corn was conducted with a number of farmers where the conditions were favorable for the development of new and improved varieties of these crops. Two distinct and new types of corn and six of cotton have produced such marked increase in yield per acre as to demonstrate their value for this work. These types have been adopted by the cooperators for extensive breeding work next season.

The farmers in northern Georgia have taken great interest in this work and have visited the cooperative breeding fields frequently from the time of planting the seed until the harvesting of the crop. The Georgia Cotton and Corn Breeders' Association, the members of which are for the most part cooperators, was organized in the course of this work, and held an exhibition of samples of corn and cotton at the close of the past season, where all farmers could see the results of one year's work.

Some of this cooperative work has been inaugurated in Connecticut, especially with corn, where a variety of Yellow Dent corn has been developed which has given greatly increased yields per acre in comparison with the established Flint or other varieties. In one of the cooperative breeding fields the past season, with only the usual cultural conditions and fertilization of the soil, a measured acre yielded 133⅓ bushels of shelled corn.

Other important work in breeding has for its object the development of rust-resistant varieties of asparagus. This work is being done in cooperation with the Massachusetts experiment station. Work is also under way having for its object the development of winter oats for New England and new winter vetches and other forage crops for rotation with tobacco, corn, potatoes, etc.

SUGAR-BEET INVESTIGATIONS.

Investigations regarding sugar-beet growing have been continued during the past year along the same lines as indicated in previous reports. Special efforts have been put forward in connection with the growing of pedigreed strains of sugar beets, this work having been carried on in several States. Further comparative tests with American-grown seed and the leading varieties of imported seed have been conducted on a commercial basis with encouraging results, the amount of sugar produced per acre being somewhat greater in the case of the American-grown seed than in any of the imported varieties. The field work in the use of commercial fertilizers in connection with the growing of sugar beets is still under way. Further work is also being carried on in connection with effective cultural methods, the objects being to determine the most satisfactory depth of plowing, width of row, manner of cultivation, and other operations in connection with growing beets.

The diseases of sugar beets have received special attention during the year, and the cause of the so-called "curly-top" has been definitely determined. Leaf-spot and root-rot have been more or less destructive. Leaf-spot may be controlled by spraying with Bordeaux mixture, while root-rot may be held in check by a liberal use of air-slaked lime.

With reference to the general aspect of the sugar-beet situation it may be said that weather conditions have been more or less abnormal during the past season. Nearly all parts of the sugar-beet area suffered to some extent from lack of moisture. Notwithstanding this and the fact that other unfavorable conditions were present, the sugar beet in most instances has demonstrated its ability to withstand abnormal conditions.

PURE-SEED INVESTIGATIONS.

The pure-seed work has been extended during the past year by the establishment of testing laboratories in cooperation with the Nebraska Agricultural Experiment Station and the Missouri Agricultural Experiment Station. At the laboratory in Washington, D. C., a larger number of samples of seed have been tested for farmers and seedsmen than in previous years. As directed by Congress, forage-plant seeds have been secured from dealers and examined for the presence of adulterants. Many lots of Kentucky bluegrass and orchard-grass seed have been found to be adulterated, but the practice of adulteration has practically ceased with other forage-plant seeds.

The efforts of this Department in encouraging the use of good seeds are being appreciated, and a reflection of this is seen in the fact that several of the larger seed houses have recently established private seed-testing laboratories. On account of the lack of instruction in technical seed testing in the agricultural colleges this Department has offered assistance along this line. So far a number of seedsmen, as well as State agricultural experiment station workers, have availed themselves of this opportunity.

SOIL BACTERIOLOGY AND WATER PURIFICATION.

Relation of bacteria to fertility.—Preliminary work has been undertaken upon the soils of the various substations of the Bureau, and extensive studies are planned for the coming year, especially in regard to the influence of the practice of summer fallowing upon the nitrate-producing power of the soil flora. Although the preliminary results are inconclusive, they indicate a higher power of nitrification in the semiarid district and a greatly reduced denitrification. It would seem, therefore, that the advantage which the eastern farmer enjoys with his moist climate is partially offset by these bacterial processes.

Distribution of bacteria for inoculating legumes.—The distribution of pure cultures of the nodule-forming organisms for legumes has been continued and with slightly better success than in previous years. Experiments have been carried on with types of soil which because of peculiar conditions prevented the growth of the proper legume bacteria and consequently made it impossible to grow leguminous crops. By the preparation of extracts of the soil and gradually adapting the nodule-forming organisms to the peculiar conditions we have been able in some cases to inoculate legumes in regions heretofore inimical to pure-culture inoculation.

Investigation of farm water supplies.—A thorough examination of over 100 farm water supplies shows that rural sanitation is dangerously bad and that in a large percentage of the cases great improvements could be made at comparatively small expense. Our investigations have also shown that cursory examinations of farm supplies are usually liable to misinterpretation and that a water supply which is in reality of great purity may be condemned, and vice versa. A thorough study of a supply renders such misinterpretation impossible.

DRUG AND POISONOUS PLANT INVESTIGATIONS.

WORK ON DRUG PLANTS.—This work has for its object the establishment of new industries in the line of growing certain crops as drugs. In a previous report attention was called to the success attained in establishing the camphor industry in Florida. Further work has been pursued in this field, seed beds having been constructed and a considerable quantity of seedlings started for transplanting to the field. Certain regions of the South have been found particularly adapted to the production of drug and similar crops. In South Carolina, where one of the drug-crop stations is located, good success has been obtained in the production of paprika peppers. These peppers are used to a considerable extent in commerce, and the establishment of the fact that they may be successfully grown will open up possible industries and assist in a wider diversification of crops throughout the South.

Some important investigations in connection with hop growing have also been carried on during the year; also important work in the line of growing tannin crops. Closely allied with the tannin problem is that of vegetable dyes, which is receiving attention in this connection.

As a feature of drug-plant studies attention has been given during the year to matters pertaining to plants that may be used in the manufacture of industrial alcohol. The plant phase of this subject is being specially studied by the Bureau of Plant Industry, and efforts are under way having for their object the determination of when and where the utilization of plant products can be most successfully adopted for the manufacture of alcohol.

POISONOUS-PLANT INVESTIGATIONS.—During the past year the main emphasis has been laid on the loco-weed studies. Field studies have been continued having for their object the working out of methods of diminishing losses not requiring individual treatment. Thus far the results have not been promising. A laboratory study of the loco weed seems to show that barium is a constant constituent in loco plants which are capable of producing the disease. Feeding experiments have led to the conclusion that barium poisoning is one of the factors that has to be reckoned with in dealing with losses from loco weeds. A study of the distribution of barium in the soil and in the loco-weed flora of eastern Colorado has been begun in cooperation with the Bureau of Soils. At the request of the Forest Service special investigations were undertaken of poisonous plants growing in the National Forests. Botanical studies of the flora of the regions suspected to contain poisonous plants have been inaugurated. Plants of unknown characteristics suspected of having toxic properties are forwarded to Washington for laboratory investigation. It seems clear that the relation of poisonous plants to the grazing interests of various parts of the country is very important and demands a thorough study.

TEA CULTURE INVESTIGATIONS.—The growing and making of tea have been gradually brought to such a position by the combined efforts of Dr. Charles U. Shepard, of Summerville, S. C., and of the agents of the Department of Agriculture that it was deemed wise to limit somewhat the scope of the part undertaken by the Department. The work involved has been reduced to a matter of machinery, except the processes of pruning and picking. A working model has been built and tested in the tea gardens at Summerville, with promise of complete success. The crop of tea there is reported about the same as last year, viz, 10,000 pounds, but owing to more careful picking it has an even higher quality than heretofore.

CROP TECHNOLOGY.

A number of important lines of investigation recently inaugurated by the Department have, owing to their close relationships, been grouped under the general head of crop technology. Certain important biological studies of grains come within this category; also the new work authorized by Congress on cotton standardization and fiber investigations.

BIOLOGICAL STUDIES OF GRAINS.—In the biological studies of grains progress has been made in interpreting the terms of the original so-called analysis into biological equivalents. An increased number of investigators are turning their attention to the problems opened up in this direction, and the results obtained have found their way to the public through various important channels during the year. In all the biological studies of grain the utility of the facts discovered is considered in connection with the subject of grain grading, as well as with that of breeding, milling, and baking. In other words, these biological studies have for their primary object the securing of data which will be valuable in future work on breeding, on milling, and on baking.

COTTON STANDARDIZATION.—The subject of cotton standardization has received careful attention ever since the agricultural committees of Congress first began to give the matter consideration. Good progress has been made toward establishing the nine official standards directed by Congress. The different American and foreign cotton exchanges have responded generously to an invitation to assist in this important matter. These numerous exchanges have contributed their standards free of cost, thus insuring an extensive collection as data for the establishment of official grades. The work undertaken in connection with this important project gives full consideration to all the problems involved in the raising, picking, ginning, baling, warehousing, grading, pressing, shipping, and spinning of cotton, and at a later date it is confidently expected that the official standards will be elaborated without alteration of their fundamental character, so as to be much more useful than any standards have ever been in the past. The possibility can now be clearly seen, through technical examination of the cotton fiber of this country, of so improving cotton classification that all interested in the cotton industry will be materially benefited. Careful studies have been made of the baling and handling of cotton, and a bulletin on the subject has been prepared. The present methods of baling and handling entail an annual loss of millions of dollars. The investigations along this line, together with the adoption of uniform grades, should result in great improvement.

PAPER MANUFACTURE.—With reference to the paper work, under special authority given by the last Congress a comprehensive series of tests is being undertaken in conjunction with the Forest Service and the Bureau of Chemistry, the object being to ascertain whether or not the fibrous portions of various crops can not be more generally utilized in the manufacture of paper. In this series of tests corn, rice, and flax are receiving prominent attention. It is too early to make a full statement, but the results already obtained are regarded as promising.

TRUCK-CROP INVESTIGATIONS.

The inauguration of extensive fertilizer tests in the trucking regions of Long Island and Virginia has an important bearing upon the commercial end of the trucking business. The cost of fertilizers is the largest single item of expense aside from labor entering into the production of truck crops. The work to date indicates that two important results will follow the more judicious use of commercial fertilizers: (1) Better crop rotation and consequent soil improvement, and (2) a greatly reduced expenditure for commercial manures, together with better development in crops. The lack of humus in the soil and the excessive use of high-grade chemical fertilizers are responsible in certain seasons for decided crop shortages which improved practices easily overcome.

FRUIT INVESTIGATIONS.

Important work in connection with the pomological collections and other investigations of this nature has been carried on during the year. The Department receives many hundreds of requests for help, all of which are cheerfully met. The identification of fruits and the resulting correspondence occupy a great deal of time. More than

2,500 specimens of fruits were received for identification, including rare and little-known fruits from recently annexed island possessions. More than 50 varieties of fruits were disseminated to fruit growers and horticulturists for trial during the year.

FRUIT MARKETING.—The investigation of the problems involved in the marketing, transportation, and storage of fruits has continued during the year, the work being shaped to conform to the rather abnormal crop conditions that prevailed during the season of 1907. Notwithstanding the low quality of the winter apples throughout most of the eastern apple districts, the export movement was heavy, and under existing market conditions again demonstrated its importance to the apple industry by affording an outlet for surplus supplies. The season's experience resulted in a renewed interest among growers and shippers in the subject of grading and packing winter apples.

HANDLING AND SHIPPING CALIFORNIA ORANGES.—The work on orange handling in California was vigorously prosecuted along lines previously discussed, with a view to accumulating sufficient data under varying conditions to permit safe generalization. In this work nearly 300 experimental shipments from California to the Atlantic coast were made in cooperation with individual orange growers and cooperative associations to determine the influence of different methods of handling upon the behavior of the fruit while in transit and after its exposure in the market. The results of this work in connection with that of former years establish conclusively that it is practicable to handle the orange so carefully on a large scale that decay in transit and for a reasonable time after arrival in our eastern markets can be practically eliminated.

Tests of various fungicides that have been suggested for preventing the mold decays by dipping the fruit therein failed to reveal any efficient agent of this character.

The influence of these investigations on the orange industry in southern California is already strongly evident. A general reorganization of methods of handling labor in the groves and houses, as well as a readjustment and remodeling of many of the packing houses, has made possible a marked improvement in the handling of the fruit, with a resulting reduction of two-thirds in the losses due to decay, which formerly amounted to from $750,000 to $1,500,000 per annum.

FLORIDA ORANGE WORK.—The results of the work on orange handling in Florida, which has followed the general lines developed in California, indicated that the need of careful handling and prompt shipment after harvesting of the fruit from that State is even greater than with California fruit. The indications are that the losses there, which amount to a half million dollars a year, can to a considerable extent be overcome by handling the fruit with sufficient care to avoid mechanical injury. The work is receiving hearty cooperation from the growers and shippers of the State.

FRUIT STORAGE.—Comprehensive tests of the behavior of apples in storage from different producing sections in New York, Iowa, Colorado, and California have been continued with a view to determining the best methods of handling the fruit to insure the longest keeping in sound and wholesome condition. Strikingly important results have been obtained in the storage of a number of varieties of table grapes in California, which it has been found possible to hold from sixty-five to one hundred days in excellent condition when packed in fine ground cork, where similar fruit packed in the ordinary commercial way could be held but from ten to twenty days. The possibility of displacing the present large importation of foreign grapes for winter use with fresher fruit of better quality and of American production renders this work of special importance to American grape growers.

VITICULTURAL INVESTIGATIONS.—The cooperative vineyards on the Pacific coast, established primarily for the purpose of determining the adaptability of resistant stocks to vineyard soils and the congeniality of the leading varieties to such stocks, have reached a point where they may be expected to yield important results along those lines. Comprehensive work on the discovery and development of improved varieties of the Rotundifolia type of grape, of which the Scuppernong of the South Atlantic States is the best known, is also well under way.

ADAPTABILITY OF FRUIT VARIETIES.—The principal study of the adaptability of fruit varieties to soil and climatic conditions has been in the Ozark region of Missouri, Arkansas, and Oklahoma, a special study of early apple varieties in the Middle Atlantic States having been completed. Types and varieties adapted to the needs of farmers and ranchers in the semiarid regions of the Great Plains area and the best methods of handling them are being studied in a dry-land fruit garden at Akron, Colo.

PECAN CULTURE.—Comprehensive studies of the adaptability and relative value of pecan varieties in the Southern States have been commenced, many problems requiring attention having come to light in connection with this rapidly developing new industry.

DOMESTICATION OF THE BLUEBERRY.—One of the most delicious and popular small fruits is the blueberry. The whole market supply comes from wild bushes. Various attempts have been made to cultivate the blueberry, but without commercial success. In the hands of a few horticulturists the bushes are fairly successful as ornamental plants, but they fruit sparingly. An investigation of the blueberry has been in progress in the Department for the past two years, and a partial knowledge of the facts essential to an understanding of the cultural requirements of the plant has been acquired. It has been discovered that on its roots grows a fungus, and that this fungus is beneficial to the plant, the vigor of the plant being directly proportional to the amount of the fungus borne upon its roots. The blueberry grows best in acid soils rich in humus and organic matter but poor in available nitrogen. It is now believed that the special function of the fungus is to assimilate nitrogen, either from the decaying leaves in the soil or from the atmosphere, or from both, and to carry it to the roots. Experiments to ascertain the exact physiological operations of the fungus are now under way, and practical tests are being made to work out the conditions under which the plant may be domesticated and grown.

THE PASTURING OF RANGE SHEEP IN COYOTE-PROOF INCLOSURES.

An experiment in the pasturing, as opposed to the herding, of range sheep has been in operation during the past season, conducted jointly by the Forest Service and the Bureau of Plant Industry. The results of the experiment are of great significance in their bearing on the increase of the carrying capacity of the great sheep ranges in the Western States and on the improvement of range mutton and wool in amount and quality.

The experiment was located at Billy Meadows, in the Wallowa National Forest in northeastern Oregon, a district infested with coyotes and other wild animals. An area of 2,560 acres of mixed forest and grass land was inclosed with 8 miles of woven and barbed wire fence believed to be coyote-proof. The inclosure was cleared of coyotes in the spring and a band of ewes and lambs numbering 2,209 was turned loose within it. They were not herded, but were left entirely free to make their own choice of feed, watering places, and bed grounds.

The experiment was a success in every way. Although coyotes came up to the outside of the fence nearly every night during the summer, not one of them succeeded in entering the inclosure. The sheep spent the whole season in almost absolute quiet, without any molestation by wild animals. The deaths among the sheep from all causes amounted to only one-half of 1 per cent, and none of this loss was from wild animals. In three bands on the outside range immediately adjoining the pasture the losses during the same period were 3 per cent, chiefly due to animals.

Still more significant was the condition of the sheep at the end of the season. The pastured band was made up of original Merino stock bred for six years to Rambouillet bucks. The sheep were therefore of a pure fine-wool type. The average weight of the lambs at the age of 6 months was 72 pounds. Individual lambs weighed 90 pounds. In the unfenced range immediately adjoining the pasture a band of sheep of similar class and grade was grazed during the season under the customary herding system. This range was exactly similar to that in the pasture and had the advantage of being a little less heavily stocked. The lambs of this band averaged 62 pounds, 10 pounds less than the pastured lambs. The heaviest herded band of fine-wool sheep accessible for comparison had lambs averaging 64 pounds, and they had grazed during the summer on a range richer than that in the pasture. Even half-Shropshire lambs from Merino and Rambouillet ewes when herded failed to weigh as much as the pastured fine wools, the half-Shropshire lambs in the four herded bands used for comparison averaging 63, 64, 65, and 69 pounds, respectively.

In the matter of carrying capacity a still greater economy was effected. A comparison of the pasture with the ranges of five bands immediately surrounding it indicates that the carrying capacity of the land was increased 50 per cent, at a conservative estimate, by the pasture system.

The excessive cost of the fence—$845.54 per mile—was due in part to special items of expense, such as $1,037.46 for hauling wire from the railroad, $1,150.87 for clearing timber from the fence line, and the high cost of labor, $3 a day. Under ordinary conditions the fence can be constructed for $500 per mile.

The system is applicable with much greater economy to lands outside the National Forests and at lower elevations. Under suitable conditions, in such situations, a fence of this kind will pay for itself in a few years. If our land laws were such that the system could be applied to the whole of the remaining public sheep range, the product of these lands in wool and mutton, it is confidently believed, would be doubled.

GRAIN STANDARDIZATION.

Since the publication of my last annual report an unusual development has taken place in the work of grain standardization. The results already accomplished have been of value in bringing about a better understanding concerning the value of the various factors which are taken into consideration in determining the grade of any given lot of commercial grain, and have led to the formulation of more definite and satisfactory rules on grades in many of the markets.

GRAIN STANDARDIZATION LABORATORIES.—Seven laboratories are now maintained outside of Washington, one at each of the following grain centers: Baltimore, Md., New Orleans, La., New York, N. Y., Duluth, Minn., Minneapolis, Minn., Chicago, Ill., and St. Louis, Mo. Numerous requests for the establishment of laboratories in other important grain markets have been received, but the limited funds available for this work rendered the opening of additional laboratories impossible; consequently the work has been limited to the primary markets, embodying the widest range of conditions and showing the greatest variation in the kinds and classes of grain handled. In each of the laboratories now in operation the work consists principally in determining the moisture content and in making mechanical analyses of samples of grain submitted by grain inspectors and merchants, and in carrying on such special investigations in cooperation with the research laboratory which is maintained in Washington as will furnish data of value in adjusting the unsatisfactory conditions now existing in the grain trade throughout the United States. The moisture test is most frequently called for, and large quantities of corn are now handled on a definite percentage statement of moisture content. A number of cases have been reported in which the results of the analyses furnished by the laboratories have determined the action taken in appeals and otherwise served in the satisfactory adjustment of grades.

Grain transportation and storage investigations.—Within the past year some preliminary investigations were made on the changes which take place in grain while in storage and during shipment from country points to primary markets or to the seaboard. These investigations will be carried on more in detail during the coming year, giving special attention to the causes of the deterioration of corn during transit from the central part of the corn belt to the seaboard and thence to European ports.

Milling and baking value of wheat.—Not having the proper milling facilities in the Bureau, arrangements have been made with the North Dakota Agricultural Experiment Station for cooperative investigations during the coming year whereby a limited number of commercial classes and grades of wheat can be properly tested as to their milling and baking value. Milling and baking tests are matters of fundamental importance in connection with the investigations of the Bureau, in that standards for wheat grades are dependent almost solely on the quality and quantity of bread which can be produced from the flour, and I respectfully call the attention of Congress to the need of sufficient funds for the installation and maintenance of a fully equipped experimental flour mill.

Investigations at European ports.—Of recent years many complaints have been received from European grain merchants concerning the badly damaged condition in which much American grain arrives at European ports. During the past year experts of the Bureau of Plant Industry have made a special study of the condition and quality of American-shipped grain at the time of its discharge at European ports. These investigations have shown that the reports of our consuls have been very conservative and that the complaints of the European grain receivers are well founded. As in similar investigations during previous years a number of cargoes of corn were examined, and the grain in some of the holds was found to be hot and in a badly damaged condition, even though it carried a certificate of No. 2 Prime Sail. The dissatisfaction on the part of foreign dealers has become extremely acute, and it is evident that if conditions do not show improvement our export grain trade will be seriously affected.

INSPECTING AND GRADING COMMERCIAL GRAIN.—While many of the influential grain dealers of the country are working hard to bring about a more satisfactory and uniform system of inspecting and grading grain in the various markets, it is believed, as stated in my last annual report, that the end to be attained can be brought about only through National inspection of all grain entering into interstate and foreign commerce.

MEASURING MOISTURE CONTENT BY ELECTRICITY.—As a result of work conducted by the Bureau, an electrical method for the rapid measurement of the moisture content of grain, requiring only two or three minutes for a determination, has recently been devised. This method can be used in cars and elevators and will doubtless prove of great value in connection with the grading of grain.

DRY-LAND AGRICULTURE.

This important work, inaugurated several years ago by the Bureau of Plant Industry, is being pushed as rapidly as the means at hand will permit. The work covers three principal areas: (1) The Great Plains region; (2) the southwestern section, including the dry portions of Texas, New Mexico, Arizona, and California; and (3) the intermountain region, including the Great Basin of Utah and the arid lands which can not be irrigated throughout the mountain States of the West. A number of the branches of the Bureau are contributing to the work and all are in close cooperation.

STATIONS FOR THE INVESTIGATION OF DRY-LAND CONDITIONS.—Eleven stations have been established in the Great Plains area where carefully planned scientific investigations are being carried on to determine the best methods of tillage, rotation, and crop sequence. Seven of these stations are in cooperation with the State experiment stations of Montana, North Dakota, Nebraska, and Kansas. Four of them are not in cooperation with the State experiment stations and are located in South Dakota, Colorado, and Texas. The actual field investigations are under the immediate supervision of a corps of trained specialists who are familiar with local conditions and farm practices, as well as the scientific problems involved. While the nature of these investigations is such that they must necessarily require a continuance for a long term of years to obtain the most satisfactory results, the information already obtained has proved of great value in giving advice and assistance to actual and prospective settlers upon the semiarid lands. It is the first time any systematic attempt has been made to secure definite facts which, it is believed, will eventually form the basis of agricultural practice throughout the area mentioned.

General work in the semiarid sections.—In addition to the various lines of work which have already been mentioned under their respective heads as being conducted in the western portions of the country, the Department is now actively engaged in the following projects having for their object the aiding of farmers in the arid and semiarid portions of the West: The introduction and testing of new drought-resistant corns from Central America and new cottons from the same region; the extension of drought-resistant cereal and grain crops of various kinds into all parts of the semiarid belt; the development of dry-land orchard fruits, including dry-land olive culture; the extension of sugar-beet culture; the utilization of native plants, such as the cactus, and numerous other lines of work.

FARM MANAGEMENT.

The work which has now been carried on for several years under the general head of "Farm Management" is growing in importance and value. Its object, as previously explained, is to bring together and carry to the man on the land the best knowledge of how to make agriculture more profitable and at the same time conserve or build up the fertility of the soil. Research and experiments are not a part of this work, but the results secured in this field by the Department and the experiment stations are applied. The work is distinct from that of cooperative farm demonstrations, as explained under another heading, in that the class of farmers dealt with have, owing to more fortunate surroundings, been placed in a position to undertake advanced lines in the general improvement of agricultural practices.

Work in the South.—The continued clean cultivation of cotton and corn in the South has destroyed the humus of the soil. Special attention has been given to methods of supplying humus. Improved systems of crop rotation and general farm management are being outlined and put into practice by many farmers who are cooperating in a very cordial way with the Department. Crops which have been secured by other branches of the Department are called to the attention of reliable men who are willing to test and try them, and in this way various cereals, forage crops, etc., have been quite generally extended. In handling work of this kind every important factor which may bear on the successful production and handling of the crop must be taken into consideration. Alfalfa is being advocated in a number of sections with excellent results.

NEW ENGLAND SYSTEMS OF FARMING.—In the Northeastern States it is becoming more and more important to shift the systems of farm management and general cropping systems to the end of meeting the increasing prices for concentrated feeds. The primary object of this work is to outline and secure the adoption of cropping systems which will result in the production of large quantities of protein on the farm, making it practicable to omit to a considerable extent the purchase of the higher-priced feeds.

WORK IN THE MIDDLE WEST.—The continued advance in the price of land is having a marked effect on the systems of farming. In addition, the exhaustion of the soil under exploitive systems of farming has brought about radical changes. A special line of work conducted during the year has for its object the investigation of the possibilities of introducing successful agriculture in the jack-pine plains of Wisconsin, Michigan, and Minnesota. These lands are wild and sandy, and under ordinary methods of cropping are not profitable. Certain systems of farming, involving the growing of clover for seed, are found profitable in the region. A bulletin outlining this important line of work has been published.

WORK IN THE PLAINS REGION.—With a view to rendering assistance to the many people who are giving up their farms in the more humid regions and securing cheaper lands in the dry sections of the West, studies of successful farms in these drier regions are being made. During the present year the Department has been making a careful study of the experience of a number of farmers who have remained on the land since the first settlement a generation ago. Some of them have worked out satisfactory methods of farming in regions where farming generally has not been successful. The experience of these men will be brought together and published in the near future for the benefit of others who are trying to make a living under these adverse conditions.

The Bureau, in addition to the line of work already indicated, is engaged in some special studies having to do with fertilizer practice; in important studies of some rare forage crops which may possibly be suitable for the South, such as cassava, in some highly important investigations of the weed problem and its bearing on farm management; and also in studies involving the utilization of the cactus, which now grows so extensively in our southwestern regions, as a forage crop. The value of cactus has been fully demonstrated and the details of its cultivation are now being worked out.

RELATION OF FARM MANAGEMENT TO SOIL SURVEYS.—As pointed out elsewhere in this report, important changes have been made in the matter of soil surveys. The regional and detail surveys now being made will, it is believed, form a useful basis for studies of farm practice not only by this Department, but by station workers as well. It is planned to follow up the work now being done, especially in the Great Plains area, to the end of utilizing the soil factors as developed by the survey in the general aid of farmers in the region. In all this work it is recognized that the successful production and disposal of the crop in any region are influenced by many factors. The factors themselves and their relationships must be studied before intelligent advice can be given to the farmer.

FARMERS' COOPERATIVE DEMONSTRATION WORK.

The object of the farmers' cooperative demonstration work now being carried on in the South by Dr. S. A. Knapp is to place a practical object lesson before the farmer, illustrating the best and most profitable method of producing the standard farm crops and to secure active participation in such demonstrations by the farmers themselves. It is an effort to teach the farmer to help himself through the influence of good local assistance, aided and guided by such means as the Department may find it necessary to supply.

The practical value of the work can be estimated by its growth. Congress has made a yearly appropriation for its maintenance in the States where the Mexican cotton boll weevil is present, and the General Education Board of New York, being impressed with the results, asked to cooperate with the Bureau in extending the work east of the Mississippi. Beginning in 1906, this Board has supported the eastern or " extension division " of the work, which includes the cotton States from Mississippi to Virginia, by an appropriation annually increased till the sum of $76,500 has been allowed for the year 1908–9. From one farm in Texas and one agent in 1903 the work expanded in 1908 to 32,000 farms with 157 field agents, covering portions of 11 States from Texas to Virginia, inclusive. In numerous cases, when appeals were made for greater extension of the work and there were not sufficient available funds to meet the added expense, counties or business organizations have cooperated in paying half or more of the salary of an agent. As organized under the Bureau of Plant Industry, its working forces consist of 1 director, with assistants, 10 State agents, and 147 district and local agents. Weekly reports are made by all agents to the director, showing work accomplished each day.

It is stated to the farmers that they can increase their crop yields two, three, or four fold at a reduced cost per acre, and that this may be almost a net gain by producing upon the farms the food supplies for family and teams. They are asked to prove it by working an acre or more according to directions. The necessary work on this part of the farm must be done by the farmer and not by a Government agent, because the whole object lesson is thereby brought closer to the people. The demonstrating farmer understands it better because he does the work. His neighbors believe that what he has done they can do. The agent makes monthly inspections of fields and gives additional instruction.

COOPERATIVE WORK.

The Bureau of Plant Industry has a great deal of cooperative work under way. Cooperation is carried on with practically all of the State experiment stations. The Bureau is also cooperating with the Forest Service, the Bureau of Chemistry, the Bureau of Soils, and other branches of the Department. Important cooperative arrangements have been established with the Office of Indian Affairs, and through the cordial support of that Office there has been secured a 55-acre testing and demonstration tract at Sacaton, Ariz., on the Pima Reservation. This station is now doing some most excellent work and is being thoroughly equipped for the same through the courtesy of the Indian Office.

In order to promote the successful development of the new projects put under irrigation by the Reclamation Service, this Department has started experimental work on several projects in the Western States. On three of these projects small experiment farms have been established during the past two years. The use of the necessary land, water, and permanent equipment for these farms is furnished by the Reclamation Service, and the experimental and demonstrational work is carried on by this Department. The aim of these experimental farms is to secure thorough and careful trial of new plants that are introduced by the Department, to ascertain and demonstrate the tillage and irrigation methods best suited to each locality, and to provide a place for the special investigators of the Department to carry on field experiments along their particular lines. As an instance of the value of these farms in the introduction and establishment of new crops there may be noted the case of Egyptian cotton in the Southwest, an account of which is given on page 42.

WORK ON GARDENS AND GROUNDS.

The care of the gardens and grounds surrounding the buildings of the Department proper has, as heretofore, been made a feature of the work of the Bureau of Plant Industry. Our physiological, pathological, and horticultural houses are now well grouped and well provided with facilities for conducting the wide range of investigations made necessary by the different laboratories in the Bureau. During the year two new greenhouses have been erected and are devoted largely to experimental work. Owing to changes in buildings of the Department it has been necessary to shift a considerable portion of the work formerly conducted on the southern portion of the grounds to the houses on the north side. A large number of plants have been received, propagated, and distributed during the year. Special efforts have been put forward toward the ornamentation of the grounds and the development of an interest in horticulture through means of flower shows, special plantings, etc.

ARLINGTON EXPERIMENTAL FARM.

The plan of soil improvement adopted in the management of the Arlington Experimental Farm is proving to be more effective than was anticipated. The work forcibly demonstrates the value of cowpeas and crimson clover as soil enrichers. The nitrogen gathered by these crops, together with the mechanical benefits obtained from turning under large quantities of organic matter, has transformed a cold, inert, and unproductive soil into one which is loose, friable, and productive. This work is of great value, because it demonstrates the method which any land holder in the South Atlantic States may follow to restore high productive power in his soil at small cost.

CONGRESSIONAL SEED DISTRIBUTION.

The Congressional distribution of seeds and plants was carried out along the same general lines as in previous years. The regular distribution of standard varieties of vegetable and flower seeds was made, and the cooperative distribution of selected varieties of cotton, tobacco, and other seeds developed by the Department was carried on with gratifying results. The work of packeting and mailing vegetable and flower seeds was seriously interrupted in November, 1907, by the almost complete destruction by fire of our seed warehouse. Congress promptly appropriated a sum sufficient to cover the loss, however, and the work was resumed about January 1, 1908, in temporary quarters. All of the vegetable and flower seed was distributed in ample time for spring planting in the various parts of the country, although the fire resulted in delaying the final shipments about one month beyond the usual time for completing the distribution.

FOREST SERVICE.

PROGRESS IN NATIONAL FOREST ADMINISTRATION.

Mastery by the Forest Service of one of the greatest practical forest problems ever undertaken by any Government is advancing apace.

Briefly stated, that problem is to develop to its highest usefulness a total area of 168,000,000 acres of wild lands, mainly mountain wilderness, but closely related to the welfare of the entire West, and therefore of the entire country. The progress of the year was marked along both administrative and technical lines.

From an administrative standpoint the most striking fact of the year was the remarkable increase which took place in the volume of business transacted, or, in other words, in the actual use of the Forests by the public. This increase is partly brought out by the following statement:

	Per cent.
Increase in area	11
Increase in number of timber sales	236
Increase in amount of timber cut	102
Increase in number of free-timber permits	76
Increase in number of special-use permits	67
Increase in number of grazing permits	11

The growth in the volume of business arising from use of the Forests has created a very serious administrative problem. Last year 78 per cent of the time of the administrative and protective force was taken up by the demands of National Forest business. The average forest area to each officer supposedly available for patrol duty was about 120,000 acres; but with more than three-fourths of the time of these officers occupied with timber-sale, grazing, and other business, the force actually available for patrol was equivalent to about one man to each 500,000 acres. That under these circumstances the fire losses in a year of exceptional danger were kept down to a very small figure in comparison with the value of the timber exposed and the damage from forest fires elsewhere is a matter of congratulation.

The risk incurred, however, is out of all proportion to the added cost which more adequate protection would involve. With the further growth in business which is certain to take place during the present year, even less protection can be given than has been given in the past. Indeed, the point has now nearly been reached at which it is not even a choice between providing for the needs of those who would use the Forests and protecting the Forests themselves. Were the entire energies of the administrative force to be given to business which use of the Forests involves, it would soon be necessary to curtail use from inability to handle the business with the means available.

Regarded as property, the National Forests justify liberal expenditures for their protection and improvement. At $2 per thousand feet stumpage, the merchantable timber alone forms, just as it stands, an asset worth something like $800,000,000, while the very moderate grazing charge yielded the Government last year an income of nearly $1,000,000. It is a safe prediction that within twenty years the Forests will bring in from the sale of timber alone an annual net income of as many millions of dollars.

An average wood production of 30 cubic feet to the acre of commercial forest is a moderate estimate of what will ultimately be obtained under management. One hundred million acres of such forest would allow to be cut each year over 3,000,000,000 cubic feet, or from 20,000,000,000 to 25,000,000,000 board feet, without diminution of the supply. This is but a fraction of the country's consumption of wood at the present time, but at the stumpage prices which already obtain in the older and better settled parts of the United States its sale would bring the Government each year from $80,000,000 to $125,000,000.

It is true that both the total and the per acre expenditures upon the Forests last year were greater than in former years, but the increase in the cost of administration was far less than that in the volume of business. Including an expenditure of about $600,000 for permanent improvements, there was spent on the National Forests in the fiscal year 1908 over $3,100,000 out of total expenditures by the Service of $3,400,000, as against about $1,500,000 out of a total of $1,900,000 in 1907 and about $1,000,000 in 1906. The executive and protective force at the close of the year numbered 1,362, as against 1,245 for 1907 and 858 for 1906. The area of the Forests was at the close of the year about 168,000,000 acres, as against 151,000,000 acres at the close of 1907 and 107,000,000 acres at the close of 1906. On this basis the expenditures per acre for the three years were 18, 10, and 9 mills.

These figures, however, partly disguise the facts. In the first place the great increase in acreage which took place during 1907 was principally in the latter part of the year. Again, the expenditures for 1908 include those for permanent improvements, which are not properly chargeable as a part of the cost of administration and protection. The same is true of the heavy outlays for field equipment, instruments, furniture for new supervisors' offices, and similar articles, necessitated by the increase in the area of the Forests.

Nevertheless, it remains true that the per acre cost of administration was higher in 1908 than in previous years, principally because of the increase in business to be transacted, but the percentage of increase in this cost was much smaller than the percentage of increase in the volume of business handled.

The increase in expenditures was made possible by the agricultural appropriation act of 1907, under which the Forest Service received for 1908 $2,385,765.71, and by the existence of a surplus of $1,172,922.36 derived from receipts from the National Forests before July 1, 1907, and therefore available for expenditure during the fiscal year 1908. In the year 1907 $908,328.66 was expended from the receipts, which amounted for the year to $1,571,059.44, but there was carried forward from the receipts of the previous year a balance of $510,191.58, thus making up the surplus stated above.

Since the receipts from National Forests are no longer available for the expenses of their administration, the sole support of the Service during the year 1909 is the appropriation carried by the agricultural appropriation act of 1908, amounting to $3,896,200. This compares with a total sum of $3,558,688.27 available in 1908, or an increase of less than 10 per cent. Since the area of the Forests at the beginning of the fiscal year 1909 was greater by about 11 per cent than at the beginning of 1908, the per acre expenditure provided for is slightly less than in 1908. With the growth in use which is taking place there is every reason to fear that it will be impossible to supply facilities for the prompt transaction of business, and there is absolute certainty that efficient protection of the Forests can not be given. I am convinced that the provision made for the care and use of the National Forests has become inadequate to their needs, and I have therefore submitted estimates for the fiscal year 1910 which ask for a substantial increase in the appropriation.

WHY EXPENDITURES EXCEED RECEIPTS.

Were it wise to do so, the receipts from the Forests could very easily be made not only to keep pace with the expenditures, but to return to the Government the entire cost of maintaining the Forest Service. Private owners of grazing lands in the same regions ask and receive a very much higher return per head of stock for the use of their lands than does the Forest Service. The National Forests, which contain one-fifth of the standing merchantable timber in the country, furnished last year about 1.3 per cent of its lumber cut, resulting in the removal from the Forests of about one-eighth of 1 per cent of the stand. Of this comparatively insignificant amount cut, one-fourth was not sold, but was given to home builders and communities; yet the sales brought in nearly $900,000. If the chief object of the Forests were to produce immediate income, the amount received could be multiplied several times. There is actually going to waste in the woods each year, through decay and other natural causes, from five to ten times the amount of timber now being cut.

With an adequate force of Forest officers available much of this waste might be prevented. Timber sales involve, for marking, scaling, and supervising the work, a cost to the Government of about 30 cents per thousand feet, and the amount sold can not be much increased without an increased appropriation. There is also the waste of the productive power of the Forest, which can not be brought into full play until the mature trees have been removed to make room for a growing crop.

Yet other considerations are involved. Most of the National Forest timber is beyond reach unless heavy outlays are made to obtain means of transportation. Such timber can be sold only to those who command large resources of capital, and even then only at a relatively low price. On the other hand, where the demand for the timber is good and competition for its purchase fairly brisk, it is generally necessary to go slowly because of the certainty of future requirements. In short, the question of the timber that can safely or wisely be sold is a local one. The fact that timber is rotting in the woods in distant regions will not help communities which find their home supply exhausted.

For these reasons the sales of National Forest timber are carefully guarded. In consequence the receipts have for the time being lagged behind the expenditures. In 1907 the Forests brought in more than was spent upon them. In 1908 the expenditures exceeded the receipts by more than $1,200,000. The difference in the showing of the two years is a result of the recognized necessity of considering future needs in preference to immediate revenue. That the country may have timber when it will want it most, the Government is virtually investing the difference between the receipts and the expenditures, for it is not merely protecting the present merchantable timber from loss by fire, but is also increasing the stock of young trees which will make up the future Forest supply.

I am now restricting the sale of timber from the National Forests in accordance with a policy dictated by the public interest. The timber lands of the West, outside of the National Forests, are mainly in strong hands. Were the National Forest timber offered on the market to every purchaser, the main scene of western lumbering would be quickly shifted to the public holdings. It is sometimes asserted that the creation of the National Forests has played into the hands of monopolists of timber lands. It was, on the contrary, an eleventh-hour halting of the process which would soon have made the hold obtainable by such a monopoly complete. To permit the owners of standing timber to preserve their stumpage intact while supplying their business needs through purchases from the Government would simply invite the hoarding of private timber for further high prices, while the public supply would be disposed of without an adequate return.

Under the timber-sale policy now in force both the present and the future interests of the consumer are borne in mind. The needs of those dependent on the Forests are supplied up to the limit set by the power of the region to maintain a steady yield. It is recognized, also, that the removal of mature timber to make room for a new and growing crop is the only way by which the Forests can be put to work. Small sales are, however, preferred to large sales; and large sales which would tend to expose the consumer to monopoly prices are uniformly refused. Requests made by prospective bidders for the advertising of over $2,400,000 worth of timber were refused during the past year.

One result of this policy has been to bring about a decline in the average price of stumpage sold. In general, higher prices are obtainable through large than through small sales. The most important consideration in making sales of timber, however, is not the price obtainable, but the serving of the public interest. Obviously, to sell timber in quantity at less than the market price through any other method than competitive bids would simply work to the profit of specially favored individuals; but care must be taken at the same time both to prevent local consumers from being overcharged by those who buy stumpage from the Government, and to prevent the exaction of a monopoly price for stumpage by the Government.

PERMANENT IMPROVEMENTS.

The agricultural appropriation act of 1908 included an item of $500,000, which was made available for permanent improvement work on the National Forests. The object of this work is to help open up the Forests to more use and provide means for their better and more economical protection, through the supply of means of communication and transportation, well-located field quarters, fire lines, fences to assist in the handling of stock, and watering places. These improvements are essentially investments of capital, which add greatly to the value and usefulness of the Forests.

The work completed during the year included 3,400 miles of trails, 3,200 miles of telephone line, 100 miles of wagon road, 40 miles of fire line, 250 bridges, 550 cabins and barns, and 600 miles of pasture and drift fences. In addition to the sum provided by the special-improvement fund, over $100,000 from the general fund of the Service was turned from current expenses to defray the cost of this work, but much of the work planned and urgently needed could not be carried out because there was nothing with which to pay for it.

Detailed estimates covering a total of $2,000,000 for permanent improvements, which it was desired to complete in 1909, were submitted to the Congress. They showed for the entire amount exactly what it was proposed to undertake on each National Forest, and at what cost. The amount provided by the appropriation was $600,000. For 1910 estimates will again be submitted for permanent improvements, the cost of which aggregate $974,981. These estimates are the result of specific and fully itemized plans, which are on file in the Forest Service. They are in no sense a request for a lump sum, the spending of which remains to be planned in detail after appropriation is made. It is of urgent importance that this work should be provided for.

Though the construction of permanent improvements entails the need of provision for their maintenance, the added efficiency of the Forests as economic resources secured through these improvements richly repays the cost. With the National Forests as with any other resource, their returns depend on the extent to which development takes place through judicious outlays of capital. If the land is not to remain a wilderness it must be made serviceable to the needs of civilized man by constructive expenditures.

THE ADVANCE IN TECHNICAL METHODS.

Through the cutting of timber on National Forests the actual practice of forestry is being put into effect by the Forest Service on an extensive scale. The end sought is, of course, the largest permanent supply of economic needs which the application of expert knowledge to a technical problem can bring about. With the best intentions, plans to make the most of a great productive resource will miscarry unless foresight is supplemented by practical experience and an actual command of good methods.

When the Forest Service undertook the management of the Forests it confronted a problem of first-class magnitude and extraordinary difficulty. Scientific knowledge in the light of which the work should be directed had to be gathered while the work itself went on, for there was no way to learn how to manage American timber lands most effectively except by managing them. The practice of forestry on the Government's holdings was better during the past year than ever before.

The direction in which improvement was most marked was, naturally, in closer adjustment of methods to local conditions, through modifications of general rules of practice to fit the individual case. In forestry, as in agriculture, the best results require intensive methods. Though nothing approaching intensive management of the National Forests has yet been reached or can be reached without a very great increase in the technical and executive force, progress toward such management is being made at a very gratifying rate.

All timber to be cut is marked beforehand by the Forest officers. The efficiency of this work depends on the wisdom with which rules for marking are laid down and the skill with which they are applied. In both respects the work of the year bettered previous practice. Special marking rules for each National Forest were prepared and put in force. Where it was found that a shortage of the supply of timber for meeting local needs is to be feared, the marking system was modified to provide for the cutting only of trees which have made their full growth or are dying or diseased. Thus, the thriftier merchantable trees are left for a second cut from the same area within fifteen or twenty years. The selection of seed trees was improved, more complete use of the timber felled was secured, and more dead and low-grade timber was sold. In these and many other ways the standard of technical work on the Forests was raised.

The fire record also deserves mention. Since the fiscal year ends in the midst of the fire season, reports of fires are made not for fiscal but for calendar years. During the calendar year 1907 the loss of timber by fire was less than half that of the previous year, though this in turn was less than ever before. About one-seventh of 1 per cent of the Forests was burned over in 1907, with a damage so slight as to be practically negligible. The ratio of loss to the value of the timber protected, allowing that it is worth $2 per thousand feet, was about as 4 cents to $1,000. The entire cost of National Forest administration was equivalent to a charge of one-third of 1 per cent on the value of the timber protected—surely a cheap insurance rate.

This immunity from fires must be ascribed chiefly to the results of the consistent efforts made in the past to inform the public as to the danger of carelessness in the use of fires in the Forest and to the recognized necessity of vigilance to put out small fires. With reasonable cooperation on the part of the public to prevent fires and reasonable provision for discovering and fighting fires when they start, really heavy losses are entirely preventable. The widespread forest fires of recent months are a case in point. Relatively little damage was done to the National Forests at a time when the air was thick with smoke almost from the Atlantic to the Pacific coast, and most of the National Forest loss which was suffered, amounting to perhaps $1,000,000, was due solely to the fact that the area to be protected is so vastly out of proportion to the resources at the disposal of the Forest Service.

THE NEED OF PRIVATE FORESTRY.

In its application to the management of private holdings forestry has lagged far behind its record of progress on the National Forests. With a fast-diminishing timber supply and steadily rising lumber prices the vast bulk of our cutting is done destructively. This is a matter which seriously concerns the public welfare.

Ten years ago the Department of Agriculture offered, in pursuance of investigations in forestry, and in order to disseminate a knowledge of improved ways of handling forest lands, to cooperate with private owners through expert advice and assistance in planning and putting into practice forest management for their holdings. The investigations thus made possible were of the first importance. But for them the Government would have been altogether unprepared to undertake six years later the scientific management of the National

Forests. They were in fact the foundation and virtually the beginning of practical forestry in the United States.

This offer has never been withdrawn. The work which its fullfilment involved was the chief cause of the rapid growth of the Forest Service between 1898 and 1905. Since 1905, however, the necessity of providing first of all for the needs of the National Forests has compelled curtailment of expenditures for general investigations, since neither men nor money have been available to carry them on.

The following table shows the number of applications received each year since July 1, 1898, and the total areas for which examinations were asked and made. There is added also a statement of the expenditures of the Forest Service for all purposes other than National Forest work during the same period.

Year.	Number of applications.	Acreage for which assistance was asked.	Acreage for which examinations were made.	Expended for other than National Forest work.
1899	123	1,518,592	400,000	$28,520.00
1900	35	964,450	878,670	48,520.00
1901	38	288,555	788,890	88,520.00
1902	37	1,904,476	1,620,600	172,182.17
1903	94	947,047	421,172	262,566.42
1904	136	3,878,930	340,612	272,809.19
1905	167	1,447,272	505,383	340,953.32
1906	160	770,023	2,083,189	234,400.54
1907	91	283,176	808,638	262,175.89
1908	57	998,576	203,714	297,840.40

It would appear from the figures that there has been a decline since 1905 in the number of applications for assistance. This has not been the case, since the figures represent only the formal applications. There has been a steady increase in the number of informal applications, but many of these were not encouraged to fill out the necessary blanks, since neither men nor money were available to make the examination.

There is urgent need to enlarge this work. The time is ripe for a widespread taking up of forestry by private owners of timber land, large and small, if the Forest Service can be in a position to guide and assist a general movement through fulfillment of its offer. None of the National Forests is east of the Mississippi River, and nine-tenths of the expenditures of the Service are on behalf of the National Forests. It is a national duty to protect and put to best use this great resource which is directly under the charge of the Government; but it is no less a national duty to promote in the East the spread of methods through which this part of the country also can preserve its Forests.

WORK OF THE YEAR.

The activities of the Service fall under the main heads of National Forest administration, Federal and State cooperation, and General investigations.

NATIONAL FOREST ADMINISTRATION.

The number of National Forests under administration at the beginning of the year was 169, and at its close 182. In both cases the only National Forest not under administration was the Luquillo, in Porto Rico. The administrative, executive, and protective force numbered 1,512 at the beginning of the year, and 1,961 at the end.

Certain lands within National Forests are covered by unperfected claims. Under the general land law such claims can be initiated only under the mining laws, or for land which is found by the Secretary of Agriculture to be chiefly valuable for agriculture, and which is recommended by him to the Secretary of the Interior for listing for settlement and entry. Claims initiated before the National Forests were created, mining claims, and claims for agricultural land listed as above may be perfected in exactly the same manner as claims for lands outside of the Forest. All questions of compliance with the land laws are by law within the jurisdiction of the Department of the Interior. Since the duties of the Forest officers require them to be familiar with the land embraced within National Forest claims, the Secretary of the Interior has requested this Department to make reports of such conditions, and Congress has authorized the Forest Service to assist the Department of the Interior by ascertaining and reporting the actual facts on the ground. Since few Forest rangers have a practical knowledge of mining, the Forest Service has called to its assistance geologists from the United States Geological Survey, and has employed mining engineers and practical miners to make reports upon mining claims. During the past year reports were made to the General Land Office on more than 6,000 claims for lands in National Forests. Of such reports 76 per cent were favorable. Action by the General Land Office, which resulted from reports made for several years previous, resulted in the cancellation of invalid claims to 50,000 acres of land bearing over 330,000,000 feet of merchantable timber. Every precaution is taken to avoid injustice to those holding claims. The claims which have been canceled by the Department of the Interior are those which were made for speculative purposes, and not for the permanent development of the lands. This work of examination is producing good results and is promoting the bona fide development of farms and mines. It increases the burdens which rest upon the National Forest force, but the expense to the Government occasioned by such examinations is repaid many times by the land and timber saved from speculative and fraudulent claims.

Examinations of lands under the act of June 11, 1906, led to the listing for settlement of about 240,000 acres of National Forest land.

The amount of National Forest timber sold during the year was slightly over 386,000,000 feet, or not much over one-third the amount sold the previous year. The falling off was directly due to the refusals to make large sales. Under such sales the actual cutting is allowed to extend over several years. The amount of timber cut and paid for during the year, however, more than doubled the cut of the previous year, with a total of not quite 393,000,000 feet. The receipts from timber sales were about $850,000, as against not quite $670,000 for the previous year. In addition there was cut under free use over 130,000,000 feet of timber, valued at about $170,000.

Reforesting of large areas of the National Forests is called for primarily in the interest of the water supply of the West, but also, though less pressingly, for the sake of an enlarged timber supply. Broadcast sowings were made during the year in 27 Forests, in 8 States, to test by experiment the extent to which reforestation may be hoped for through the use of this method. The National Forest nurseries in which are being grown stock for transplanting were enlarged and about 700,000 trees were planted. Over 2,000,000 trees will be ready for planting in 1909.

The beneficial results of regulated grazing, shown in a decided betterment of much of the National Forest range, made it possible to increase the allotment of stock on a number of the older Forests. At the same time investigations in range improvement through reseeding, new methods of handling stock, the eradication of poisonous plants, and the destruction of prairie dogs brought important progress toward still better future use of the Forests by stockmen. The development of watering places is another means that is being pursued to the same end, while the killing of predatory wild animals by Forest Service hunters saved the stockmen losses probably greater than the entire amount paid in grazing fees. This amount was over $960,000. Through the enforcement of quarantine regulations and the distribution of blackleg vaccine other losses from disease were prevented.

FEDERAL AND STATE COOPERATION.

At the request of the Secretary of War, supervision of the sale of mature and dead timber on the Fort Wingate Military Reservation, in New Mexico, was undertaken, and examinations were made of the timber on three eastern reservations for which forest management is contemplated. Through an agreement with the Secretary of the Interior, I have undertaken that the Forest Service shall assume charge of the management of forests on Indian reservations. Under this agreement the Forest Service has assumed charge of logging and milling the timber on the Menominee Indian Reservation, in Wisconsin.

Cooperative State forest studies were carried on with Kentucky, New Hampshire, and Illinois, and advice was given on request concerning forest taxation and other matters of legislation in many States, including Alabama, where a comprehensive forest law was enacted.

GENERAL INVESTIGATIONS.

A careful study of forest, water, and land conditions in the Southern Appalachian and White Mountains, authorized by special appropriation of Congress, made clearer the industrial and economic importance of forest preservation in these regions, for the sake of timber supply, water and power supply, navigation, and the control of floods.

Through cooperation with private owners investigations in forest management and forest planting were continued. It was possible to make field examinations of only about one-fifth of the total acreage for which advice concerning forest management was sought. Every tract of land on which the advice of the Service is applied becomes a valuable experiment in practical forestry. The total area for which examinations have been made since cooperation was first offered is nearly 11,000,000 acres, and on more than three-fourths of this some form of forestry is now in actual practice.

The studies in wood preservation and in the strength and physical properties of different kinds of wood maintained the position of the Forest Service as leader toward more economical use of wood material. Special attention was given to working out practicable methods for treating farm timbers in small quantities. Studies in wood pulp making showed that a merchantable pulp can be made from 15 woods not commonly used. Along many other lines also data were gathered looking to better knowledge and control of our Forests and better use of their products. At the same time, the work of bringing to the attention of the public the knowledge gathered for the use of the public was vigorously prosecuted.

BUREAU OF CHEMISTRY.

The report of the Chemist records the progress made during the first year of the execution of the Food and Drugs Act. The manifold difficulties in the organization and inauguration of such a work are apparent even upon superficial consideration of the subject; and, when one considers the scientific problems involved, the necessity of training the majority of the increased force, whether scientists or inspectors, and the double duty of securing justice for the manufacturer and the consumer alike, it is apparent that it is the part of wisdom to make haste slowly, particularly in regard to some decisions which are especially far-reaching in their effects. In putting the law into operation, every effort has been made to avoid working hardship upon any one. The decisions of the Board of Food and Drug Inspection as reached have been issued in a series of leaflets and have been widely distributed to manufacturers, dealers, and importers, that they might be aware of the attitude of the Department in regard to the points raised. At the same time much of the moral effect of the law depended upon a vigorous enforcement of its provisions, and such enforcement was plainly due the consumer for the protection of his health and his purse. It has been the endeavor of the Department to pursue a purely impartial and equitable course, giving due weight to all of these considerations.

INSPECTION UNDER THE FOOD AND DRUGS ACT.

A statistical statement of the samples taken and analyzed, seizures made, and prosecutions brought conveys practically no idea of the volume of work involved or the effect produced on the quality of food products. The number of branch laboratories has increased from 6, examining only imported products, to 21, analyzing both interstate and foreign samples. These laboratories are located at the following points, selected because of the control afforded interstate commerce: Boston, Buffalo, Chicago, Cincinnati, Denver, Detroit, Galveston, Honolulu, Kansas City, Mo., Nashville, New Orleans, New York, Omaha, Philadelphia, Pittsburg, Portland, Oreg., St. Louis, St. Paul, San Francisco, Savannah, and Seattle. The number of inspectors was increased during the year to 39 and approximately 13,400 samples have been collected and distributed among the branch laboratories and to the Division of Foods and the Division of Drugs of the Bureau of Chemistry. Inspectors are assigned to the branch laboratories and to such other points as afford an advantageous situation in regard to the interstate distribution of supplies. Of the samples analyzed and found to be adulterated, 814 were found to have been collected under such conditions that prosecution could be brought. Data in regard to such cases are checked first in the Division of Foods or the Division of Drugs of the Bureau of Chemistry at Washington and then are referred to the Board of Food and Drug Inspection for recommendation and reference to the Department of Justice for legal action.

In addition, the inspectors have collected data necessary to institute proceedings for the seizure of 86 shipments for confiscation by a process of libel for condemnation. The shipments include cider, honey, coffee, flour, canned fruit, sirup, molasses, wine, meal, beer, vinegar, stock feed, and canned vegetables. These seizures usually represent large quantities of the products, as, for example, 135 barrels of cider, 40 cases of coffee, 2,240 sacks of flour, or 1,078 barrels of wine. In some cases the shipment was destroyed, for instance, 84 bags of coffee colored with lead chromate. In many other cases, where only misbranding is involved and this may be corrected by relabeling, the goods are returned to the owner upon payment of costs and the delivery of a bond not to dispose of the product contrary to the law. This feature of the law has not proved uniformly desirable, inasmuch as the manufacturer has in some cases failed to comply with the terms of the bond, necessitating an additional expenditure of labor and money for his reapprehension.

In considering the volume of work accomplished by the inspectors, the difficulties attending the collection of interstate samples must be considered, there being marked differences between the conditions under which the State inspectors work and those attending the work of the Federal inspector. In the latter case interstate transaction must be shown and the samples must be identified with the shipment received at that particular time, collection must be made in the original unbroken package, and it must be shown that the goods were received by the dealer subsequent to January 1, 1907. Further, the Federal inspector is not clothed with the police power conferred by the State, and no penalties are laid for hindering a Federal inspector in the performance of his duties. In this connection attention should be called to the fact that the manufacturers have shown a commendable spirit in their attitude toward the inspectors, and the steady growth in cooperation of manufacturers with the Government in the pure-food propaganda speaks well for the spirit in which the inspectors have done their work as well as for the progressiveness and honesty of the American manufacturer.

In addition to the collection of samples, the investigation of factories and work in cooperation with the chemists of the branch laboratories in conducting special investigations have played no small part in the activities of the inspecting force. The routine collection of samples of misbranded whiskies was supplemented by a special effort to locate large shipments of the product manufactured from neutral spirits and misbranded, under the decision of the Attorney-General, as straight whisky or blended whisky. Seizures have been made to the extent of 82 barrels and 6,702 cases, action in regard to the greater part of which is pending, and libel proceedings have been requested affecting 625 barrels and 31,359 cases of food and drug products.

Other subjects of special investigation by the inspecting force include distilled colored vinegar labeled as pure apple or cider vinegar; durum wheat flour bleached and marketed under a brand that was misleading as to quality; watered or adulterated milk entering into interstate commerce at certain large centers; edible gelatin as associated in its manufacture with the gelatin used in the arts; and packages of cheese overmarked as to weight. As the inspectors in the present year will be called upon more and more to serve as witnesses in the courts, and the work of organization is now practically complete, it is apparent that the inspection force must be largely increased to insure a thorough enforcement of the law.

SPECIAL FOOD AND DRUG INVESTIGATIONS.

FLOUR.

A cooperative investigation in regard to the bleaching of flour and the use of durum wheat in flour milling was undertaken at the St. Paul, Chicago, and Washington laboratories, with the aid of the inspectors. In regard to the use of durum wheat, the leading millers were interviewed, the composition of 47 samples was determined, and a study was made of wheat mixtures affording information which had been much needed in regard to the branding of wheat flour. Seizures have been made and judgments obtained as to the misbranding of wheat flours which were mixed with flour from durum wheat and labeled hard spring wheat flour. The investigation in regard to bleaching flour was more extensive, as it called for a thorough study of the methods of grading and the results of baking tests, as well as chemical and physical examinations, before a conclusion could be reached. Over 1,000 determinations have been made in this study, and the investigation is nearing completion.

CANNED GOODS.

Special investigations, combined with factory inspection, have been made in regard to the canning of peas and the making of tomato ketchup. In the former case studies as to the grading of the product in connection with the question of proper branding have been made, and the effects of bleaching and the causes of spoilage have been studied. The ketchup experiments were made at a factory offered for the purpose, and included the manufacture of ketchup without preservatives, the causes of spoilage, the length of time elapsing both before and after opening when spoilage would take place, no preservative being present. Studies were also made of the antiseptic value of the spices, sugar, and vinegar employed. Methods of processing were also studied, and commercial brands were examined and compared with the experimental product. In connection with these studies it is of interest to note the increasing importance of the microscope in the detection of adulteration, the presence of bacteria, fungi, and other signs of fermentation and decay being easily demonstrable by micro-chemical examination.

DRUG INVESTIGATIONS.

The investigation of imported drugs involved the examination of 568 samples, representing many phases of adulteration and misbranding. Illustrative of these may be mentioned dandelion root, adulterated with 20 to 40 per cent of sand and small pebbles; belladonna root, highly adulterated with poke root; callendula flowers, colored with saffron, imported for the purpose of adulterating saffron after its importation; and medical preparations accompanied by circulars containing false or misleading statements.

The examination of chemical reagents delivered to the Bureau of Chemistry is a very important item, underlying as it does the accuracy of the analytical work, and marked improvement has been effected in the quality of the chemicals delivered.

MISCELLANEOUS INVESTIGATIONS.

Numerous other investigations are in progress which are called forth by commercial conditions or are rendered necessary by the exigencies of the administrative work. The following are selected for comment as illustrative of the scope of the work:

Tanning materials.—The principles of tanning, the quality of the final product, and the source of supply of tanning materials are studied with a view to conserving the oak and hemlock forests from which these materials are largely drawn, as well as to improve the finished product. Other sources of tannin are investigated, and the desirability of establishing extracting plants in the vicinity of the raw supply, thus enabling the tanner to use other parts of the tree as well as the bark without an increased cost of transportation, has been suggested. Investigations of the Bureau have shown that there is sufficient tannin in other parts of the tree to warrant its use, but not its transportation in bulk.

Potable waters.—The extent to which mineral waters are being used rendered an examination of these products as they enter into interstate commerce advisable. Examinations accordingly were made of samples obtained at the sources of the waters and also as bought on the market. While it would be unfair to imply that the majority of these waters are sophisticated, nevertheless it has been found that a goodly number are contaminated in handling, as shown by the bacteriological findings, or are not true to label. The latter is especially apt to be the case in regard to mineral waters, the content of special constituents supposed to have medicinal value being very small. As bottled waters are depended upon for special purity and for use in illness, it is plain that a high standard should be maintained and the product should be true to label. The object of the investigation under way is to assure the public that potable waters in interstate commerce may be depended upon in these particulars.

UNFERMENTED FRUIT JUICES.—Experiments in the manufacture of unfermented fruit juices without the use of preservatives have been conducted on an extensive scale. Tests of methods of manufacture and of storage in glass, in tin, and in wood, including shipping tests, have been made, and it has been positively proven that palatable beverages may be made and may be kept by sterilization by heat only. This work is of interest both to the manufacturer and to the farmer, who can make profitable use of fruit products not marketable and which in most cases go to waste.

DISTILLED LIQUORS.—The manufacture and handling of distilled spirits was studied in detail. This work included an inspection of the large distilleries of the country and the inauguration of experimental work at a Kentucky warehouse, where 60 barrels received from various distillers were set aside to determine the effects of various methods of treatment. Other phases of the investigation include careful studies of the methods of analysis and the determination of the composition of American whiskies, based on a large number of samples obtained from the principal distilleries of this country.

HONEYS.—A chemical and microscopical study of honeys of known origin and of commercial honeys had a direct bearing on the questions arising under the food law in regard to interstate samples. Careful studies of methods of analysis were made for the determination of adulterants, and the microscopical studies serve to identify the honeys as to their source by ascertaining from the pollen grains present the plants visited by the bees, the labels generally stating that the honey is from some particular floral source. Seizures of honey containing invert sugar and glucose have been made, and the data obtained in this investigation were needed for practical application.

LEMON EXTRACTS.—Claims made in regard to the large quantities of lemon extract imported, especially from Italy and Sicily, could not be substantiated otherwise than by a study of the conditions under which the product was made, as it was claimed that certain variations were due to local conditions. The lemon-oil industry in Sicily was accordingly investigated and the exhaustive line of samples is now being analyzed. The data thus afforded will solve the problem presented by this line of imported goods.

Commercial alcohol.—The study of the manufacture of industrial alcohol from the wastes of the farm and of sugar-producing plants has been inaugurated on a large scale. A plant manufacturing 75 gallons per day has been installed, and experimental runs, using corn, melons, small fruits, canning wastes, etc., will be made on a commercial scale. From these experiments it is expected that calculations can be made as to the comparative value of different wastes and materials for this purpose.

WORK IN COOPERATION WITH OTHER DEPARTMENTS.

While special investigations have for many years been conducted in cooperation with certain Departments, the practice of referring miscellaneous samples to the Bureau of Chemistry for analysis is constantly increasing, and there is hardly a Department for which some work is not done. The leading lines of cooperation are as follows:

A wide range of contract supplies, principally for the Bureau of Engraving and Printing, the Isthmian Canal Commission, and the War Department, are examined. The extent of the saving effected by the chemical control of articles delivered under contract and the raising of the quality of the supplies becomes more apparent with the progress of this work, and the analyses of paints and inks for the Bureau of Engraving and Printing have increased 50 per cent in the last year. The new work for the Isthmian Canal Commission promises to be especially effective, as without it the officials would be entirely at the mercy of the contractor were the goods delivered before inspection.

Two important lines of work conducted in cooperation with the Post-Office Department include paper investigations and assistance given in excluding from the mails certain fraudulent material, especially proprietary and patent medicines. Besides the tests of deliveries of paper for the Post-Office, similar tests are made for the Public Printer and the Bureau of Engraving and Printing. The actual testing of the samples is supplemented by research work looking to the improvement of the quality of paper and the methods of manufacture and to the conservation of the raw materials. Specifications are being prepared which, it is believed, will greatly reduce the cost of the Government paper supply without any injury to quality or the permanence of the records. During the year a laboratory was established at Dayton, Ohio, in order that papers for the Post-Office Department might be checked in the vicinity of the mill and the supplies be made to agree with the specifications before delivery, thus saving annoyance to the manufacturer and the buyer.

In regard to the drug work it is believed that the centers of propagation of fraudulent remedies and " cure-alls " have been broken up, and that in time this far-spreading evil will be practically destroyed so far as the mail service is concerned.

In collaboration with the Department of Justice investigations have been made in several localities, especially at Anaconda, Mont., and Ducktown, Tenn., in regard to the injury to vegetation and live stock by the waste products from smelters. The contamination of the air by arsenic and sulphur dioxide in the smoke emitted, which injure the trees and vegetation, and the danger from lead, zinc, and copper in the wastes thrown upon the land or into the streams have been made the subject of scientific inquiry. The results are used by the Department of Justice in bringing prosecutions for injury to public lands.

BUREAU OF SOILS.

To the Bureau of Soils is intrusted the study of the soil resources of the United States. There are three important steps in such a study. The first is to ascertain accurately by actual field investigation the extent, the location, and the boundaries of each and every distinct soil type in the country and to state its actual condition and efficiency as a factor in the annual production of new agricultural wealth. This work is being accomplished through the soil survey.

The second step is to ascertain those properties of soils, physical, chemical, and organic, which render each soil fitted to continue to produce profitable yields of crops, and to ascertain by what methods of cultivation, crop rotation, and fertilization the efficiency of each soil may be maintained and increased. This work is being done by the laboratories of soil physics, soil chemistry, and soil fertility.

The third step is to study all processes by which the actual soil substances are wasted or their properties essential to crop production are impaired, and to devise methods whereby such waste and impairment may be decreased or totally prevented. This work is being done through the investigations of the greatest source of soil wastage—soil erosion.

SOIL SURVEY.

The work of the soil survey was actively begun in 1899, when Congress first appropriated money for the purpose of making soil surveys. Since the inception of this work there have been surveyed 306 different areas in 44 different States and 2 Territories, exclusive of one area in Porto Rico. A soil survey is now in progress in one of the two remaining States, and one will be completed during the present fiscal year in the other State.

A total area of 157,078 square miles, or 100,529,920 acres, has been included in this work, and the Bureau of Soils maintains a field force of 62 men, working in different parties and completing detailed work in about 60 different areas, covering a total area of approximately 40,000 square miles each year.

In addition, reconnoissance surveys of 135,000 square miles annually are being conducted in the Great Plains and in the Appalachian Mountain and Plateau regions.

There are on file at the office of the Bureau of Soils requests for 478 additional soil surveys, covering nearly 500,000 square miles of territory.

A soil survey determines the exact character of the various soils, and their location and extent in each area is studied. It also ascertains their present use and capabilities by personal observation of the field force and the report of practical farmers owning and operating the soils and the farms investigated. It summarizes all of the present knowledge of these soils, whether obtained from the farmers who are cultivating them, from the chemical, physical, and fertility investigations of the Bureau's laboratories, or from the experimental and research work of the various State institutions concerned. It also enables all soil investigators and agricultural experimenters, as well as the farmers, to make direct comparisons between the soils of any one locality and of all others in the United States. It presents an unprejudiced statement of fact concerning each soil and its uses in each area, and, wherever possible, also forecasts and advises additional and more profitable occupation for each soil. It presents to the farmer a statement of what the full capabilities of his soils are and of the crops produced and methods of cultivation and soil management employed throughout the region in the successful handling of these soils. It gives to the investor and the home seeker those statements of fact concerning soil and agricultural conditions which are essential to insure safe investment and a satisfactory home. It calls attention to the undeveloped soils and their capabilities and the lines of their safe occupation and profitable development. It serves as a summary of the best that is known about soils and a forecast of the best that can be discovered. Such service is essential to the individual welfare of the citizen and to the well-balanced, systematic development of the National soil resources.

The importance of the soil survey as a factor in National development may be judged from the fact that the value of the annual products of the soil has now reached $8,000,000,000, and in the conservative estimate of the experts of the Bureau of Soils this stupendous amount might easily be doubled within the next twenty years through a complete comprehension of the full capabilities of soils now cultivated and the discovery of the proper uses for soils not now cultivated. Such an undertaking is worthy the careful consideration of all who desire the present achievements of American agriculture to be surpassed by those of the immediate future and by all who desire to provide a secure foundation for all the industrial activities of the Nation.

The necessities of that population for which the United States must provide under normal conditions of increase of population demand that all agencies leading to the increased efficiency of soils should be fostered.

WHAT THE SOIL SURVEY HAS ACCOMPLISHED.

The record of the practical accomplishments of the soil surveys can not be told in figures showing the area covered and the breadth of distribution of the different surveys. The interests served—the agricultural development obtained by these surveys—furnish a better basis for estimating the value and importance of the work.

While the European countries have been debating the possibility of such investigations in their own regions the United States has covered a territory greater than many of them possess. And yet the total area covered by detailed soil surveys in the United States is a little less than two-thirds that of the State of Texas. Compared with the accomplishments along these lines by foreign nations, the progress of soil-survey work in the United States has been rapid. Compared with the vast continental area yet to be covered and with the demands made upon the Bureau, it has been slow.

In the New England States the soil survey has aided in the development of the tobacco industry in the Connecticut Valley, in the reforestation of mountain and hill lands in New Hampshire, and in the study of the exceptionally valuable potato soils in northern Maine.

A complete soil survey has been made of the State of Rhode Island for the use of the farmers of the State and of the experiment station.

In New York State the soil survey is cooperating with the State college of agriculture, and the reports are used as a basis for agricultural and horticultural surveys by that organization. The chief problems are those of more intensive farming in the region of the so-called "abandoned farms" in southern New York, the extension of the grape industry through central New York, and the outlining of the lands peculiarly suited to the production of alfalfa in all parts of the State.

In Pennsylvania there is a strong demand for additional soil-survey work in connection with the work of the State college of agriculture in determining the crop adaptations and fertilizer requirements of the great variety of soils found within the State.

In Delaware, Maryland, and Virginia the soil survey is aiding in the development of the trucking industries along the Atlantic seaboard, of the dairying and live-stock industry in the Piedmont section, and of the fruit industry in the mountain lands. The further development of all these industries depends upon the thorough knowledge of the soils and of their ability to produce the different crops suited to these different sections.

In North Carolina the Bureau of Soils is cooperating with the State department of agriculture, and that institution is following the work of the soil survey by establishing branch experiment stations in such localities as have been covered by the soil surveys. The Bureau of Soils is aiding in the development of the swamp lands which have been and are to be drained in the eastern part of the State; in the development of the Piedmont section of the State, where the prevention of soil erosion is an important problem; and is studying the fruit lands of the mountain section, and determining the relative proportion of land suited to forestry and to agriculture.

In South Carolina the work of the Bureau of Soils is aiding in the extension of the trucking industry and the production of Sea-Island cotton in the coast section and in further diversification of farming based upon a thorough understanding of the soils of the entire State.

One of the most notable accomplishments of the Bureau of Soils is the development and extension of the tobacco industry in southern Georgia and northern Florida, in Alabama, and in east Texas, whereby the area planted to tobacco has been more than doubled since the inception of soil survey work in the region and the profits derived by the farmers have been more than quadrupled in the last six years.

In the Central States the study of the corn soils and the separation of these from the soils peculiarly adapted to wheat production is being conducted. In Michigan and Wisconsin a study has been made of the sugar-beet soils and of the possible extension of sugar-beet production. The work of investigating the agricultural possibilities of the soils of the cut-over pine lands in Michigan and Wisconsin has just been begun. It has been found that considerable areas of land well suited to agricultural occupation exist within these regions and that they need to be carefully distinguished from other soils which are practically worthless for the production of annual crops, but which in the northern parts of both of these States might well be reforested.

PROBLEMS IN THE USE OF SOILS.

The great problem of the northeastern States is so to utilize their soils that they may produce upon an intensive scale those crops which yield large returns per acre, which have a particular market value in the great seaboard cities, and which may be produced practically without competition from the more level central prairie States. The great variety of soils in the northeastern States and the fact that they have been farmed for two centuries practically to grass and grain crops makes it necessary to show the farmers of the section that these soils have other higher values than the production of the cereal crops and hay. Any change which may be brought about by this knowledge will be slow and gradual, and it is necessary first to demonstrate the desirability of such changes and then their possibilities.

In the South Atlantic States the problems are similar, except that large areas of unoccupied land still exist, and that the problem of the drainage of a portion of these lands along the coast and the determination of their crop value is paramount. Farther inland, in the Piedmont section, the prevention of soil erosion is one of the chief problems.

In the Gulf States the development of special industries along the coast is showing uses for lands which have previously been considered of little or no agricultural importance, and lands once held at a nominal value for their timber stand now have a greater value as agricultural lands even after the timber has been removed. This is largely due to the fact that their agricultural uses have been shown by a number of well-located soil surveys.

The problems of the central prairie States have in general been well worked out by the farmers of those States, and, until economic conditions in the United States change, the chief value of the soil surveys in the different States will be to enable the farmers to compare directly the best methods to be employed in the handling of their different soils. The other important problem is to determine the character of the soils in the vicinities of the large cities, in order that a local market-garden supply of vegetables and fruits may be raised near to the point of consumption. The greatest problem of the Upper Lake region is to determine the extent of agricultural lands and their uses in the cut-over timber belt.

In the far West the opening of Indian Reservations and the extension of irrigation systems annually make available for agricultural purposes large tracts of land about which there is little or no information, so far as the nature of the soil and its peculiar fitness for various crops is concerned. The change from extensive grain farming to intensive methods of agriculture in the fertile valleys of California and Oregon is likewise making available large tracts of land that under the changed conditions will support a population many times as large as formerly. Expert knowledge of the soil and its power to produce fruit and truck crops is essential to make such worthy enterprises successful.

All new tracts of land of this character are widely advertised and the cautious home seeker avails himself of all information that will enable him to make a wise selection of soil. In such areas where soil surveys have been made the reports are eagerly sought for, but the increase in the number of new and favorable localities in the fast-developing Western States emphasizes the necessity of making these additional soil surveys if the Department is to furnish this informa- to the farmer.

In Oregon and Washington, where the removal of the original forest growth has progressed sufficiently far to permit the farmer to engage in agriculture, the soils have yielded well all those truck and fruit crops which are in great demand in the Alaska mining districts. Additional surveys are needed in these northwestern forested areas to help the people to a better understanding as to just what these soils will produce.

The Bureau has continued active cooperation with the Reclamation Service in surveying the soils of the various projects under construction. This is likewise essential to the complete success of these undertakings on the part of the Government to make homes for the people in what are at present arid wastes.

RECONNOISSANCE SURVEY OF THE GREAT PLAINS REGION.

A noteworthy achievement just accomplished is the completion of a reconnoissance survey of an area of approximately 40,000 square miles in western North Dakota, in the Great Plains region. This region includes that portion of the country west of the one hundredth meridian and east of outlying ranges of the Rockies, extending from the Canadian boundary on the north to the Rio Grande on the south, and contains several hundred thousand square miles.

The transformation of these plains into prosperous farming communities has progressed rapidly during the past few years, owing largely to fertile virgin soil, favorable rainfall conditions, and proper dry-farming methods. Detailed soil surveys in various parts of this extensive area have given the new settlers exact knowledge of the soils of certain restricted localities, and in order to protect the interests of the homesteader it seemed imperative to complete as soon as possible a general or reconnoissance survey of this entire region to determine just what soils can be expected to yield remunerative crops in dry seasons as well as in years blessed with abundant rainfall and what crops can be grown most profitably.

In the area completed in North Dakota large yields and the rapid extension of railroad facilities for shipping grain crops have given an impetus to settlement, and so at present all the public lands have been filed upon except the rough portions of the Bad Lands, where the cattle industry still predominates. With but few exceptions the new settlers are prosperous, since in the more level portion of the State the soils are generally fertile, and, with proper management to conserve moisture, produce good crops.

With the completion of this area in North Dakota and the advent of cold weather the reconnoissance field force will be transferred to south Texas, where an area of several thousand miles will be surveyed, the party returning to complete the survey of eastern Montana the following spring.

In my opinion this reconnoissance survey of the Great Plains should be vigorously prosecuted until complete knowledge of the soil conditions in the form of maps and reports for the entire region is available to all who wish to make homes in this section of the country.

LABORATORY INVESTIGATIONS.

The laboratories of the Bureau of Soils are maintained mainly for the support and aid of the field parties. During the past year they have accomplished a largely increased amount of detailed analytical work to this end, necessitated by the increasing activities in other branches of the Bureau's work. Besides this, however, the laboratories have continued their fundamental investigations on the relation of the soil to plant growth, some of the results of which it is proper to notice here.

FACTORS TO BE CONSIDERED.

It is now recognized that a farmer in handling his soil is in much the same position as the foreman of a factory, and to get the most out of his plant and raw material it is necessary to establish as perfect a control as possible of raw material, processes, and product. To obtain this control in the case of the soil, it is necessary to understand the fundamental relations between the plant, the soil, and the weather and similar conditions of environment, and the relation of one crop to another as affected by different types of soil, etc. In studying these problems it has come to be recognized that we must consider first three things: (1) The plant; (2) the soil moisture, which is the great food source of the plant; and (3) the mixture of solid mineral and organic compounds of the soil which determines the nature of the soil solution on which the plant feeds. These three things have this in common, that they are always more or less in motion. Not only the tops, but especially the roots of a living plant are constantly in motion, and if for any cause the motion stops the plant must die. The soil moisture is constantly in motion, for when the rain falls upon the earth a portion enters the soil, passing with comparative quickness through the larger pores and openings into the subsoil and lower depths, but with the return of fair weather a large part of this water slowly but steadily rises through the finer pores and on the surface of the soil grains to the surface of the field, bringing with it from the lower depths much dissolved material, which is thus made available to the plants in the surface layer. Finally, the solid grains are constantly moving among themselves. Every time a soil is wet or dried it changes volume, which means that the soil grains are constantly moving, as a soil in the field is always changing its moisture content. Every growing root causes some movement of the soil grains. Earth worms and burrowing insects play their several parts. Every breeze that blows removes some little soil from the surface of the field or else adds some from elsewhere. Every shower moves to some extent the surface soil. The sum of these movements is within a few years astonishingly large, and there is a profound change as far as the individual particles of the soil are concerned in every field, subsoil becoming surface soil, surface soil removed or replaced by materials from divers places, etc.

These movements which lie at the basis of soil fertility and crop production are all more or less readily affected by the three practical methods of control which human ingenuity has devised—cultural methods, crop rotation, and fertilizers or soil amendments. These movements in turn determine the physical, chemical, and biological conditions in any soil and its suitability for the production of any given crop or rotation of crops. Broadly speaking, the investigations of the laboratories of the Bureau of Soils aim to elucidate and make clear, and if possible give quantitative expression to the interrelations between these fundamental and natural soil phenomena and the known methods of control, with a view to improving the latter, reducing them to a logical basis, and removing them from the condition of empiricism in which they have so long remained.

RELATION OF PHYSICAL PROPERTIES OF SOIL TO MOISTURE CONTENT.

The relation of the physical properties of the soil to the moisture content has been further studied. It has been shown that there is a critical moisture content where the water in the soil ceases to be entirely in the form of films over the surface of the soil grains and some of it is in the form of ordinary free water in the interstitial spaces. The free water can be easily removed, as, for instance, by mechanical means, while the film water is held most tenaciously by forces measuring thousands of pounds to the square inch. This critical moisture content corresponds to the condition familiar to practical farmers and gardeners and referred to as the "optimum water content," supposedly because plants could most readily obtain their needed water when the soil was in this condition. The researches of the Bureau have shown, however, that the true explanation is that this particular moisture content is that at which the soil can be put into the best possible physical condition; that it is different for different soils, but the same for all ordinary plants on any given soil. It is the moisture content at which plowing, harrowing, or other methods of cultivation will produce the best results and give the greatest porosity, aeration, and penetrability to plant roots. Laboratory methods for determining this critical moisture content, with precision, have been developed, and it is now a comparatively simple matter to determine this important datum for any given soil.

It has further been shown that the diffusion of heat into a soil (a most important factor in the germination and early growth of a crop) takes place most readily when the moisture content is slightly greater than the optimum, but is greatly retarded by a content much above or below this point. This investigation has also brought out important information regarding certain special methods of cultivation, as the flooding of cranberry marshes, etc.

SOIL EROSION.

In connection with the work on soil erosion which the Bureau is carrying on, a laboratory method has been devised for studying and comparing the erosiveness of different soils, and it now appears, contrary to popular opinion, that the soils of our Southern States are not inherently different from northern soils in this regard, but that the greater amount and extent of soil erosion observed in the South is due mainly to the torrential character of the rains and other climatic conditions peculiar to that section, and to faulty methods of cultivation. Practical methods for preventing and remedying erosion are now well understood, and there is a very gratifying increase in their use, but the subject yet remains one of our great practical agricultural problems. In this connection the studies on flocculation and sedimentation have been continued, studies which are expected not only to yield important practical results in the control of erosion, but which have an even greater value for the maintenance of the "crumb structure" and looseness of the soil so earnestly desired by farmers.

While the great carrying power of water in effecting the translocation of soil material is obvious, the importance of the wind in this connection has not been so generally recognized. Important movements of soil material by water take place only occasionally, and then in restricted areas, as along river courses, etc., while the wind is acting practically all the time and throughout the entire extent of land surface. An important and careful investigation has been made by the laboratories this past year, which shows among other things that the aggregate translocation of soil material by wind is many hundreds, perhaps thousands, of times that produced by water, and through incomparably greater distances. The wind, in fact, is the great important agency in effecting that great complexity and heterogeneity of soil composition which recent investigations here and abroad have shown to characterize soils as distinguished from mere rock powders. This heterogeneity of soil composition is one of the most important fundamental generalizations of modern soil work, and has been confirmed by another investigation conducted in this laboratory during the past year, in which it was shown that the common rock-forming minerals are present in all soil particles, no matter whether they be coarse or fine. That is to say, that in every grade of soil material from sands to clays there are the same minerals, carrying the important mineral plant foods, potassium, calcium, and phosphorus, although there is a tendency, as might be expected, for these substances to become segregated in the finest particles of the soil.

ABSORPTIVE POWER OF SOILS.

This segregation of mineral plant nutrients in the finer soil particles—the silt and clays and humus substances—is the more interesting, as it is these substances which show the greatest power of absorption. It has long been a matter of common knowledge that soils are good absorbers for bad odors, offensive products of decay, etc. But in the same way they have the power of removing inoffensive substances from the air or solution by condensing them in or upon their soil grains. This is a most important fact, as by it added fertilizer salts are conserved and prevented from being quickly washed out of the soil; and also the composition of the soil solution is automatically and naturally kept under control more or less effectively. A very thorough and careful investigation of this subject was continued during the past year, and the laws controlling absorption and the proper methods of handling soils to augment absorption have now been very thoroughly worked out.

COLOR IN SOILS.

An important property of soils is the color, not only because the color may directly influence the soil, as in the relatively greater power of absorption of heat by darker soils, but as indicative of differences in the character of the soil material or its past conditions, which differences are not themselves obvious. In other words, the color is "symptomatic" of some other property or condition. The differences between red and yellow soils have become almost a classical problem to geologists and soil investigators, and, aside from theoretical considerations, the matter is of practical agricultural importance, since, speaking generally, red soils are more productive than yellow ones. Systematic work has been conducted on this problem, and it now appears that the color differences may be due to one or more of several factors, such as thickness of coating, hydration of the iron oxide, etc. Incidentally valuable information has been obtained regarding the solubility of iron oxide in various mineral and organic acids and the nature of the so-called ferric salts. The solubility of iron oxide in the presence of various reagents is a question of fundamental importance in rock decomposition, soil formation, the transport of iron, and formation of iron hardpans. It is a matter of immediate practical importance in the cultivation of certain soils in Coastal Plains, for instance. Not only do the ordinary mineral and organic acids affect this solubility, but in the aggregate an enormous influence is exerted by carbonic acid. This has led to an investigation of the absorption of carbon dioxide and solution of soil carbonates, which gives us for the first time precise and definite knowledge concerning these important soil components and throws light on such practical problems as the handling of hardpans, soil conglomerates, soil drainage, etc.

INDEPENDENT INVESTIGATIONS.

A number of independent investigations have been carried on, which, while of technical importance, need only be mentioned in this connection. Thus, the chemistry of the Bordeaux mixture has been worked out; a new form of Wheatstone bridge designed for determining the soluble salts in soils, soil moistures, soil temperature, etc.; and new methods for the estimation of the organic matter in soils and of nitrates have been devised.

HUMUS.

An important and perennial subject of soil investigation is the organic matter in the soil known as "humus." Investigations of the physical and chemical properties of this substance have been continued during the year. It is a complex mixture, differing markedly in properties in different soils. The separation of the different components forming it has long defied the efforts of the chemist, but quite recently the laboratories of the Bureau of Soils have devised methods by which most gratifying progress is being made in this direction. It is not too much to expect that before many years the indefinite and rather meaningless term "humus" will disappear and we will speak of the different compounds forming it and their specific properties. Of these there appear to be two classes. The first includes the organic compounds common to most or all soils. So far as we now know these appear to have but little chemical or physiological effect on plants, but are mainly important for their physical effects on the soil. The substances of the second class are found in an individual soil or a few soils as a result of special conditions. Frequently these appear to have a profound and direct effect on plant growth.

FERTILITY INVESTIGATIONS.

In the fertility investigations of the Bureau of Soils some very important problems have been attacked and some very noteworthy results obtained which can not fail to be of the greatest value to further research in these lines and thus become of the greatest practical importance to the farmer. The soil investigator encounters many soils which do not respond to fertilizers, or if they have responded in the past, no longer do so at the present time, or at least require an entirely different system of fertilization from that necessary at the beginning. Fertilizers give in different seasons and in different years results which are not consistent but more or less erratic. The use of commercial fertilizers is constantly on the increase and conservative estimates place the expenditure at more than $100,000,000 annually. The use of fertilizers is an outgrowth of an idea formulated somewhat more than half a century ago that the growing plants removed more of one constituent than of others, thus impoverishing the soil of this particular constituent; and this must be replaced in order that the productivity of the soil might not be diminished. It was therefore proposed that chemical analysis of plant ash and of the soil would determine the needs of the soil. While chemical analysis has conferred many practical benefits on agriculture, it has effected comparatively little toward settling the great questions of fertility or sterility of our agricultural lands and of the action of fertilizers or soil amendments. The hopes that an analysis of the soil would confirm the practical experience of the farmer have not been realized, nor has the ratio of these various ingredients from the point of view of chemical analysis thrown more light on the question. Experience has shown that the action of fertilizers and soil amendments in general is not wholly explainable on the plant-food basis, and we must look to other factors for explanation of their full efficiency.

COMMERCIAL FERTILIZERS.

It is this problem that has engaged the Bureau's attention for a number of years, and the extended use of commercial fertilizers in the United States makes it imperative that a thorough understanding of the action of fertilizers be obtained, for perhaps as much as a third of the money spent for fertilizers is annually wasted and brings no adequate return, owing to this lack of understanding of the soil's requirements. One of the most interesting results of this work has been to show that fertilizers have properties of improving soil conditions in addition to the plant food which they supply, and that in some cases this action may be of even greater importance as far as practical results are concerned than the plant food added. The Bureau's exhaustive studies in this difficult field have shown that in some of the unproductive soils this unproductivity is not due to the lack of any of the mineral plant foods, but is distinctly due to the presence of harmful properties which prohibit the plant from performing its normal functions when growing in the soil. The presence of these bodies in such soils has engaged the Bureau's attention for some time, and with the methods at its disposal it has been able to show that they exist, and that the soils and the extracts from these soils possess toxic qualities.

ISOLATION OF TOXIC BODIES.

The most noteworthy advance in this work, and one which is of the greatest interest to practical agriculture, is that some of these bodies have now been actually isolated. They are not substances of mineral origin, but form a portion of the organic matter of the soil. It appears that in previous investigations of soils the organic matter has not been adequately considered, the investigators contenting themselves with determining the amount of organic matter present and the total nitrogen available in this organic matter. The researches of the Buréau therefore throw a great deal of light on the functions of organic matter in the soil. During the past year the Bureau has studied further this organic matter, with a view to determining its relation to the changes which are going on in every soil.

Isolation of some of these bodies of organic origin has been very difficult, inasmuch as there has been no past work to serve in any measure as a guide, but enough results have already been obtained to show this to be a most profitable and encouraging line of agricultural research, one which has a bearing on the questions of fertility and infertility of agricultural lands and the action of fertilizers and other soil-ameliorating agencies in causing the soil to yield profitable returns. The Bureau investigations have shown that the organic matter of the soil is exceedingly complex and very little understood, either from a chemical or physiological point of view, especially in regard to its direct influence on plant growth, either as a promoting or as a hindering agent. In the past it has been valued chiefly as a means of improving the physical condition of the soil and as a source cf available nitrogen. The Bureau, however, has shown that this organic matter of the soil has a distinct bearing upon the question of crop growth, because of the presence of harmful organic constituents in some soils and beneficial ones in others, and that these are influenced in their action upon plant growth by the presence of fertilizers in soils.

ORIGIN OF ORGANIC MATTER IN SOILS.

The organic matter of soils originates from plant débris, fragments of roots, leaves, bark, stems, etc., which on the death of the plants are returned to the soil. In addition to this there is a strong indication of the presence of organic matter introduced into the soil by the living plants, either as direct excreta or thrown off by some of the outer cells of their roots so that there is a direct relationship between the living plant and the soil in this manner. This plant débris or plant excreta is then changed and altered by the processes of decay which may be induced by the action of soil bacteria, soil molds, etc., and also by chemical oxidation, by the oxygen of the air or root oxidation performed by the living roots or the enzyme secreted by them. All of these factors are, then, at work in changing the plant débris or excreta to other forms, and according to the condition which prevails the process of decomposition of these materials are shown to be different. That is, the same plant débris, or the same plant excreta, through the action of these different agencies, produce an entirely different result, producing in one case a soil rich in the dark-colored bodies, which are usually called "humus bodies," and in other cases light-colored bodies, which are entirely different in chemical properties and in some cases also in the physiological effect on plant growth. All of these various factors, then, which enter into the changes which the organic matter of the soil must undergo are being studied, and it has been shown that fertilizer salts have a very marked influence upon these actions, stimulating the oxidation which is produced in the soil by oxidation, whether by roots, by soil bacteria, or by enzymes, or even by direct chemical oxidation by the air. The influence of the purely cultural methods such as tillage in producing the proper changes in the organic materials has also been studied, and it has been shown that any alterations which produce increased aeration of the soil also tends to produce destruction of bodies harmful to plant growth, changing them to compounds that are harmless or even beneficial to crops.

INFLUENCE OF GREEN AND STABLE MANURES.

Other investigations of the Bureau during the past year have been the study of the influence of green manures and stable manure on plants and on the soil compounds. These researches have shown that properly decomposed green manure contains compounds which are beneficial to plant growth, aiding the plant to overcome any toxic conditions which may be in the soil in which it is grown to such an extent that a permanent effect upon the fertility of the soil is thereby brought about. The stable manure has been differentiated into organic and inorganic materials in the laboratory, and it has been shown that the organic materials have even greater influence in producing the healthful growth of crops than the mineral ingredients, although these aid materially.

BIOCHEMICAL RELATIONSHIP OF ORGANIC MATTER.

Throughout these investigations there has been a departure from the accepted lines of study of the problems of soil fertility in that the organic matter and its biochemical relationship have been especially studied. The influence of plant upon plant and of plant upon soil has been studied, as well as soil upon plant, and these studies have shown that one plant is capable of affecting the growth of another plant, and that one kind of crop when growing continuously upon the same soil will have an effect upon the soil which renders it unfit for remunerative production of that crop, though not necessarily affecting the production of another crop. These relationships have been carefully studied and in some cases it has been possible to isolate harmful organic bodies from such soils more harmful to the crop producing them than to other unrelated crops. By such results the influence of crop rotation upon soils becomes much more intelligible and also leads the way to a proper understanding and a realization of the best system of crop rotation to be employed.

INFLUENCE OF BACTERIA ON ORGANIC MATTER.

The influence of bacteria on soil organic matter is another subject which demands further study, as the results so far obtained have shown that this action may be either direct or indirect, direct action resulting in the production of beneficial, harmful, or inactive organic compounds so far as crops are concerned, depending upon the conditions and the kind of bacteria at work. Bacteria also have an indirect effect, producing such products as ammonia, nitrites, and nitrates, and these affect the organic compounds of the soils. Still other factors of a biochemical nature must be taken into consideration. Experiments indicate a very strong influence of molds in the production of some of the bodies already isolated from the soil.

The investigations of the Bureau in the past year have thrown much light upon the problems which are before every farmer and every agricultural investigator, and the results already obtained are very encouraging.

BUREAU OF ENTOMOLOGY.

The work of the Bureau of Entomology has increased in scope and efficacy during the year. Admirable progress has been made in investigations under way, and certain new topics have been taken up.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

The work of the Bureau against these two injurious insects in New England has consisted largely in clearing up the thoroughfares leading from the most seriously infested localities by destroying the underbrush, removing poor trees, and burning all débris for a strip of 100 feet on each side of the road. The forests in many places in Massachusetts are seriously infested, and the method just described renders them comparatively innocuous as centers of distribution, since the roads through these forests are so clean that the caterpillars can not drop upon passing conveyances and thus become distributed over large areas. Scouting has been continued in Connecticut, Maine, New Hampshire, and Rhode Island, and every effort has been made to prevent incipient colonies from becoming dangerous centers. Extermination has been aimed at where possible, and prevention of spread where the colonies are larger. Work against the brown-tail moth has been carried on only along roadsides where work is being done against the gipsy moth. In Maine, Massachusetts, and New Hampshire there are State laws requiring property owners in cities and towns to care for this pest, and in those States occasional advice to property owners with regard to the removing of the winter webs is the main effort of the Government workers. One hundred and thirty miles of road in the State of Massachusetts has been cared for during the year in the way of cleaning up the border strips, both by banding trees and by spraying. The conditions in New Hampshire have been shown by scouting to be more serious than has hitherto been suspected, but in Connecticut, Maine, and Rhode Island extermination is still a possibility. The work has been admirably done, and commands the commendation of officials and citizens of the States in question.

IMPORTATIONS OF USEFUL INSECTS.

The main work in this direction has been a continuation of the large-scale efforts to introduce and acclimatize foreign parasites of the gipsy moth and the brown-tail moth in cooperation with the State of Massachusetts. Additional expert assistants have been stationed at the headquarters at Melrose Highlands, Mass., and a large amount of European parasite material has been brought over and in much better condition than in previous years. An expert has been sent to Japan who has organized an efficient service among the Japanese entomologists and has secured the sending to this country of many thousands of parasites belonging to several different species. At the parasite laboratory new methods have been devised, and it has been shown to be possible to breed both the European and Japanese parasites in large numbers in artificially heated rooms, and thus to liberate them in infested woodlands in much greater numbers than before. These discoveries reduce the expense of the experimental work and at the same time increase its efficiency. During the summer of 1908 more than 200,000 specimens of the most active foreign enemies of both gipsy moth and brown-tail moth have been imported and liberated under the most favorable conditions. In all 51 species of parasites and predatory enemies have been introduced, and all secondary parasites have been destroyed. Of the 59 species imported, there is sufficient evidence that 7 species have thoroughly established themselves. The probabilities are that many more have succeeded, but thus far it has been difficult to determine this point. There has been during the past year a tremendous destruction of the larvæ of both brown-tail moth and gipsy moth from bacterial and fungous diseases, and these diseases have in many localities killed off the parasites as well. The outlook for ultimate success is more favorable at the present time than at any period during the progress of the work. There seems no doubt whatever that eventually these imported parasites will multiply to such an extent as to render the gipsy moth and the brown-tail moth no more harmful than many of our native leaf-destroying caterpillars, but the experts of the Bureau of Entomology can not fix the date at which this desirable condition will be brought about.

A successful attempt was made to import from Europe a very effective parasite of the eggs of the imported elm leaf-beetle, an insect which has destroyed thousands of elm trees in the streets and parks of the northeastern cities of the United States, and has, by removing the leaves in July and August, injured the usefulness of many thousands more. This egg parasite has been successfully established in Massachusetts, New Jersey, and New York, and also in the District of Columbia, and it is probable that the effects of its beneficial work will be seen in the course of two or three years.

Another important effort in this line has been the sending of American bumblebees to the Philippine Islands to fertilize clover that may be grown in the Philippines, and still another effort has been the importation of the European enemies of the codling moth.

MEXICAN COTTON BOLL WEEVIL.

The work against this important pest has shown a number of promising features during the year. It has been found that native parasites are becoming much more effective in controlling the weevil. During the season the average parasitism has been shown to have doubled in Texas and trebled in Louisiana. Work has been carried on in the introducing of parasites from one region to another, with the result that in several cases the effectiveness of parasites has been greatly increased by the introduction of material from other regions. Studies of a native ant which is increasing in efficiency as a weevil enemy have resulted in the discovery of an especial method of attracting these ants to substances in which they will build their nests and in which they may be transported in enormous numbers into regions where they are not abundant.

An important apparatus for the control of the weevil has been invented and a patent granted thereon. At the instance of the Department of Agriculture this patent has been dedicated to the use of the public. The invention consists of series of chains attached to a light frame in such a way that when dragged between the rows the fallen cotton squares infested with weevils are removed from the shade of the plants and brought into a narrow pathway between the rows, where they are exposed to the direct rays of the sun. This destroys and very greatly increases the mortality of the weevils in fallen squares. The same machine has a very useful cultural effect—it fills up the cracks in the soil and establishes a perfect dust mulch.

Experimentation on a large scale has shown that planting cotton by the check-row system instead of in drills, as ordinarily done, increases the yield of cotton per acre and possibly reduces the cost of production on account of the elimination of much hand labor. Further than this it aids materially in the fight against the weevil.

Very extensive work has been done on the study of the hibernation of the weevil, with a view to its possible control during the winter. This work indicates a much more abundant hibernation of the weevil in the Mississippi Valley, but at the same time indicates measures of control which are receiving further experimental investigation at the time of this writing.

It has been shown in the Mississippi Valley that the basic method of destruction of the weevil by the fall destruction of the cotton plants becomes even more important than it was in Texas. The large-scale demonstrations of the importance of this operation carried on by the Bureau of Entomology have been widely advertised in the Mississippi Valley, with the result that during the present autumn great interest was shown by the Louisiana planters, and in one parish more than 40 per cent of the planters undertook the fall destruction of plants, which gives great promise for the success of their crops the coming year.

INSECTS INJURIOUS TO FORESTS.

Extensive field investigations have been carried on in the National Forests of northern and central Utah, northeastern Oregon, southern Arizona, southern New Mexico, and throughout Colorado to determine additional facts regarding the distribution of the principal insect enemies of the Rocky Mountain forests. Field investigations have also been conducted in the forests of private owners, and on subjects relating to the interests of manufacturers, dealers, and consumers in eastern and northern California, Colorado, Michigan, West Virginia, Pennsylvania, Maryland, New York, and northern New England to determine additional facts on which to base practical advice to private interests in forests, farmers' wood lots, and manufactured, stored, and utilized forest products. Much success has been gained in the way of securing the adoption of measures recommended by the Bureau of Entomology by the owners and managers of extensive private forest interests. The inauguration and application of insect-control policies in the National Forests has received much attention.

It was determined by a thorough inspection during the last year that the efforts of private owners and forest officials during 1905–6 to control the alarming outbreaks of the Black Hills beetle in 1904–5 in the vicinity of Palmer Lake and Colorado Springs and the adjoining Pikes Peak National Forests, under the advice of the Bureau of Entomology, were a complete success. It was also demonstrated that, in the same way, the efforts of the owners of an extensive private estate in Colorado to control the depredations of the same insect were equally successful. The first of these was accomplished by the cutting and barking of 1,000 trees, the products of which paid a large share of the cost and resulted in the protection of timber valued at more than a million dollars. The second was accomplished by the cutting and barking of less than 500 trees, resulting in the protection of timber of perhaps even greater value than in the first example. The real value, however, of these two examples of successful control is far greater than that represented by the money value of the timber protected, since they demonstrate, first, that the most destructive enemy of the pine forests of the central Rocky Mountain region can be controlled at a comparatively slight cost, or even at no expense, whenever the timber can be utilized, and, second, the absolute necessity of expert advice as a guide toward doing the right thing at the right time and at the least expense.

INSECTS DAMAGING DECIDUOUS FRUIT TREES.

PEAR THRIPS.

An investigation of the pear thrips was begun in the fiscal year, and a field station for this purpose was located near San Jose, Cal. Careful life-history studies were made, and special attention was given to experiments in the field with methods of control. Various sprays were tried, and two of them give promise of efficacy—namely, tobacco extract and distillate emulsion. Careful tests have been made with the various methods of destroying the insect in the soil, but no definite results have been reached. The importance of this problem to the fruit growers of California and other Pacific States, as well, possibly, as to the fruit growers of the East, should the insect once be introduced into the eastern orchards, is very great. Many hundreds of thousands of dollars' worth of damage has already been done in the infested region of California, and it is the purpose of the Department to continue these investigations and experiments as vigorously as possible.

CRANBERRY INSECTS.

Beginning with the spring of 1908, an investigation of the cranberry insects in the Wisconsin bogs was undertaken in cooperation with the Agricultural Experiment Station of the University of Wisconsin. Experimental stations have been established, and investigations indicate that, while the remedies to be used in the western bogs must be different from those in use in New Jersey and Massachusetts, the injurious insects may be controlled.

OTHER INSECTS.

Comprehensive investigations of the peach-tree borer and the plum curculio have been carried on at various points and demonstration field work against the codling moth has been under way at various points. Investigations and experimental demonstrations against the grape rootworm in the Erie grape belt have been practically completed, to the satisfaction of the vineyardists and to their great advantage. Studies have been made in connection with the serious outbreak of two species of bark beetles in the peach orchards of Ohio and of the grapevine Phylloxera in California. Further than this, an interesting and important investigation has been carried on relative to insects affecting drying and dried fruits in California, to determine the effect that sulphuring may have in affording protection against insect infestation.

FIELD CROP INSECTS.

THE SO-CALLED "GREEN BUG."

The great damage done by this insect in 1907 was the occasion for the beginning of a very extensive investigation to ascertain its life history and possible remedies. During 1908, however, no comparable outbreak occurred. By the end of June, over its entire range, from Texas to the Canadian border, the insect was present in limited numbers and apparently awaiting only favorable weather conditions to become again destructive. These conditions did not recur, and there was therefore no opportunity for large-scale remedial experimentation. A careful study of the insect over the greater part of its range has been made, with the result that facts have been obtained which will prove of practical value another season.

HESSIAN FLY INVESTIGATIONS.

Extensive wheat-sowing experiments have been carried on again in many States within the wheat belt. Valuable information has been gained, and the advice of the Department experts has resulted in the avoidance of much damage in several different localities. Further experiments in the transfer of parasites from one portion of the wheat belt to another have resulted in the complete saving of threatened crops, but a just estimate of the value of these experiments can not be formed until another season.

OTHER WORK.

Investigations of jointworms have been continued, and a serious outbreak of one of them in the State of Washington has shown that it is capable of doing great damage on the Pacific coast. Variations in life history on the Pacific coast indicate the desirability of further study upon which to base new remedies. Several other insects injurious to grains and grasses have been studied with profit.

INSECTS INJURIOUS TO VEGETABLE CROPS.

During the year additional work has been done on the insects affecting truck crops in Texas, Florida, and southern Virginia. The opportunities offered by this localized work in the way of experiments on a large scale in the field have shown that nearly all of these insects can be economically controlled. Insects affecting the sugar-beet industry in the West have been studied in cooperation with the State Agricultural Experiment Station of Utah, and an agent has been located in California to continue these investigations.

INVESTIGATION OF HYDROCYANIC-ACID GAS FUMIGATION IN CALIFORNIA.

This investigation was begun with the fiscal year. A thorough study was made of the existing methods, and this was followed by the institution of large-scale experiments, covering as rapidly as practicable the different features of the problem, in order to discover the best formulæ and mechanical methods and the particular dosage for the different insects involved and for trees at different conditions as to the effects on blooming or the maturity of the fruit. Many interesting problems have been evolved in this investigation, and the results already achieved have been of great value not only to the citrus-fruit growers of California but to all fruit growers who may in the future have occasion to use this process. The exact dosages under different conditions for the purple scale in California have been determined, and a study of the exact nature of the combination of the chemicals used in producing the gas, as well as the proper proportion and method of combination, has been carried on. It is the opinion of the commissioner of horticulture of California and of prominent fruit growers in southern California that the results achieved in the first few months of this investigation have already proved that ultimately many thousands of dollars will be saved to the industry.

INSECTS INJURIOUS TO STORED PRODUCTS.

An important investigation was begun during the fiscal year concerning the insects injurious to stored cereals in the mills of the South, at the request of many milling companies in Kansas, Oklahoma, Missouri, and Texas, and on behalf of the steamship owners and operators of Galveston, Tex., and New Orleans, La. One of the special subjects has been the flour beetles which injure prepared cereals, especially such as are manufactured in Kansas and Missouri and shipped through New Orleans for European ports. The underwriters who insure against this damage claim that flour shipped southward in the warmer months through the warm climate of the Gulf ports is much more liable to damage by these insects, and report that many thousands of sacks of flour shipped by that route to various European ports within the last year were seriously damaged. In the course of this investigation it has been and will continue to be the especial aim to discover the main points of original infestation—whether in the mills, on the railways, on the steamship docks, or on the steamers; and these points once determined, remedial experimental measures will be instituted.

WHITE FLY INVESTIGATIONS.

The investigation of the white fly in Florida has been continued, on an enlarged scale, under increased appropriations provided by Congress. The important work has been carried on at headquarters, at Orlando, Fla. The principal lines to which the investigation has been devoted during the year were, first, the control of the pest by fungous parasites of the white fly, and, second, control by fumigation. Many important and interesting facts have been determined concerning the fungous parasites, and the fumigation experiments have indicated a favorable outlook for the complete success of the process. An improved tent and a new form of dosage table have been devised, and the process has been simplified so that an orange grower, by following simple instructions, can fumigate his trees with the same degree of accuracy as the most experienced expert. Practical demonstrations have been carried on in St. John, Orange, Hillsboro, Manatee, and Lee counties, and great interest has been manifested by the citrus growers throughout the State.

INSECTS AFFECTING TOBACCO IN THE DARK-TOBACCO DISTRICTS.

The loss from insects in the important tobacco area in Kentucky and Tennessee known as the "dark-tobacco region" during the spring and summer of 1907 is said to have amounted to $2,000,000. Headquarters were established early in the summer of 1908 at Clarksville, Tenn., and experimental work was immediately instituted. The habits of the insects in question are already fairly well understood, and the investigation has been largely in the way of determining the most effective insecticides and the best method of application. It has been ascertained that arsenate of lead is more effective than the preparations heretofore used, and can be applied more economically. Much attention has been paid to control by cultural means, and excellent results are promised. No definite idea of the economic results of this experimental work can be gained, however, until another season.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

WORK ON THE HOUSE FLY.

Presumably owing in part to the very general spread of information contained in circulars issued by the Bureau of Entomology, the country has been aroused during the last fiscal year as never before to the danger of permitting house flies to breed unchecked and to carry filth and disease through communities. Many boards of health have taken up the matter and much work has been done to emphasize the importance of this insect as a disease bearer. During the year an especial effort has been made to learn exact facts relating to the seasonal prevalence of the house fly, with the idea of comparing, at the close of the season, the increase and decrease of the house fly with the increase and decrease of typhoid fever, in the hope of emphasizing the part played by the house fly in the carriage of typhoid. This work has been carried on in the city of Washington, and the results will be announced upon the completion of the computations.

WORK ON THE LIFE HISTORY OF THE TEXAS CATTLE TICK.

Three investigators have been at work during the fiscal year upon the facts relating to the life history of the cattle tick. As a result of this study it has become possible to lay down an important law regarding time and conditions when cattle may be allowed to run in pastures without becoming infested. This discovery is based upon the fact that the tick eggs do not hatch in the spring until a certain amount of temperature is accumulated. One of the great difficulties in the control of the tick is that many ranchers are overstocked and can not leave part of their holdings of cattle in certain fields for the time requisite to starve out the ticks. This difficulty is minimized as a result of the discovery above mentioned, since it has shown the latest date on which it will be safe for cattle to remain in pastures from which the ticks are to be eradicated or reduced in numbers. During the year internal parasites of two genera of ticks have been found, and experiments are under way in an attempt to cause these parasites to attack the cattle tick.

Studies of other species of ticks have been carried on, since it is not unlikely that they will be found to transmit diseases of various animals. This has been recently shown by the demonstration of the agency of the tick in the transmission of so-called "Rocky Mountain spotted fever" of human beings in this country. A practical demonstration was made on a large ranch in southern Texas of the application of a method of control resulting from life-history investigations. The results of this experiment were so conspicuous that the owner of the ranch thought that the pest had been completely exterminated. He was wrong in that opinion, but the experiment amounted almost to eradication and indicates what may be done by an individual cattle owner on a large ranch far south of the quarantine line drawn by the Department.

BEE CULTURE.

The work on bee culture has been enlarged, and its operations have been unusually productive. The work on bee diseases has been continued through the year, and it has been shown that the annual loss from these diseases, conservatively estimated at $2,000,000, may be considerably reduced by the application of better methods of manipulation. Testing of different races of bees has been carried on near Washington, and a study of the production and care of extracted honey, a study of the present status of bee keeping, experiments on mating queens in confinement, and other work looking toward the bettering of apiculture has been under way.

OTHER INVESTIGATIONS.

Much experimental work upon insecticides has been carried on, both under the general headings indicated above and in other ways. As usual, many suggested remedial mixtures have been referred to the Bureau of Entomology for investigation. A large amount of inspection work has been carried on. All of the seeds, bulbs, roots, bud wood, and grafts introduced by the Department from many foreign regions have been minutely inspected to prevent the introduction and establishment of noxious insects. Careful studies of scale insects and other insect pests of a miscellaneous character have been under way. Additional observations have been made upon insects injurious to shade trees, those injurious to flower gardens and greenhouses, and those injurious to the pecan.

BUREAU OF BIOLOGICAL SURVEY.

The several lines of investigation under way in the Bureau of Biological Survey at the time of presentation of my last report have been continued and new ones have been undertaken.

The material prosperity of the State and Nation depends upon agriculture, and whatever increases the certainty of agricultural operations in any way, especially by destroying the enemies of crops, directly concerns the farmer. It is from this point of view that the economic relations of our native birds and mammals are important.

The study of the habits of birds and mammals, especially of the species that prey on insects and feed on grains and fruits, is one of the chief duties of the Biological Survey. The results of this work are set forth in circulars and bulletins and widely distributed for the information of farmers and others, in order that they may know friends from foes, and so take measures to befriend the one class and suppress the other. Important as are such measures now, they must become increasingly important as time goes on and the acreage devoted to the needs of our expanding population becomes larger.

RELATION OF MAMMALS TO AGRICULTURE.

In their relations to agriculture mammals differ considerably from birds. Few birds are so harmful that their wholesale destruction is called for, since by devouring destructive insects most of them render a full equivalent for any mischief they may commit. Such is by no means true of mammals. A few are very beneficial, and the usefulness of such servants of man as bats, skunks, weasels, badgers, foxes, and moles should be known and appreciated, that their lives may be spared and they be allowed to continue their good work. Unfortunately, a much greater number of our mammals are everywhere injurious, and are the more dangerous because where they do not exist in great numbers their destructive habits often escape particular notice.

WOLVES AND COYOTES.

As the result of much experimental field work, the destruction of wolves and coyotes by locating the breeding dens and killing the young and by approved methods of poisoning and trapping have been earnestly advocated as the most practicable means of checking the increase of these formidable carnivores. Circulars describing these methods have been widely distributed to stockmen and others throughout the wolf country, with the result that during the past year more wolves and coyotes were destroyed than ever before, the total number of wolves known to have been killed being over 1,800 and the number of coyotes about 24,000. The saving of stock by this means is estimated at not less than $2,000,000.

It is earnestly pointed out that the safety of stock over the great cattle and sheep ranges of the West depends upon the persistence with which repressive methods are followed up. So long as wild land exists in vast tracts, so long will wolves find safe harborage and breeding grounds therein. By persistent effort, however, and at comparatively small cost, the number can be so reduced as to limit the damage done by them to a minimum.

FIELD MICE.

Although losses by field mice have proved a steady drain on the resources of American farmers and nurserymen, yet only occasionally and over limited areas has the damage been so great as to attract special attention. The extent of the destruction of crops by mice in the United States has never even approached that in Europe, where they have overrun whole provinces, leaving ruin in their wake. During the past year, however, a native species infested the alfalfa fields in Humboldt Valley, Nevada, in such multitudes as to destroy nearly the whole crop. Out of the 20,000 acres of alfalfa in the valley, 15,000 acres were a total loss, so that the fields had to be replowed and reseeded. During the past year the Biological Survey sent two assistants to Nevada for the purpose of conducting experiments and demonstrating to the ranchmen the best methods of destroying the animals. As the result of trials with various poisons, it was found that sulphate of strychnine on chopped green alfalfa, or when that is not procurable, on alfalfa hay, is a most effective poison. Even on ranches where the number of field mice reached the astonishing total of 12,000 to the acre, relief was obtainable by careful and systematic poisoning at the cost of only 70 cents per acre. By means of the combined efforts of the farmers of the valley, using methods devised by the Survey, the number of mice was finally so greatly reduced that the hawks and owls, gulls, herons, ravens, skunks, badgers, weasels, foxes, and coyotes, which had assembled early in the outbreak and killed at least 45,000 mice a day, were able to take care of the remainder and prevent them from doing serious damage, thus furnishing an important object lesson as to the usefulness of these destroyers of rodents when permitted to do the work they are fitted by nature to perform. A bulletin covering the subject in detail has been prepared and will soon be published and distributed throughout the alfalfa districts of the United States. Alfalfa farmers are earnestly urged to cooperate in applying repressive measures before the field mice have multiplied and assumed the proportions of a plague, since if active steps are taken in time their reduction is a comparatively short and inexpensive process. The matter assumes more than local importance in view of the magnitude of the irrigation projects now under way in the arid parts of the West, all of which are inhabited by field mice that only await a favorable opportunity to increase and become a pest.

HOUSE RATS.

The rat continues to cause great losses throughout the United States. During the past year an attempt was made to ascertain the approximate damage done to property by this rodent in the cities of

Washington and Baltimore. Many business men were interviewed, including dealers in various kinds of merchandise, feeders of horses, managers of hotels and restaurants, and manufacturers. The inquiries included all sections of the two cities and both small and large dealers. Data were obtained from some 600 firms and individuals, from which it was estimated that the annual loss from rats in Washington is about $400,000; in Baltimore, upward of $700,000. Assuming, as is probable, that similar conditions obtain in all our cities of over 100,000 inhabitants, the damage by rats in these centers of population entails a direct loss of $20,000,000 annually. This enormous sum gives an idea of the still greater total loss inflicted by this rodent throughout the length and breadth of the land.

The rat continues also to excite grave apprehension because of its agency in distributing the dreaded plague and other diseases. Boards of health and the Marine-Hospital Service in several of our maritime cities have been prosecuting active war against the rodents, and large sums have been expended in efforts to effect their extirpation. No one method has proved adequate, and only by concerted, systematic, and persistent efforts is it possible to reduce and keep down their numbers. The rat-proof construction of buildings, the constant use of traps, and the use of poisons wherever possible will go far toward assuring public safety. Experiments with various poisons and mechanical means of destruction have been made during the year, and a report on the subject with recommendations will soon be issued.

Several bacterial cultures for the extermination of rats and mice are on the market, and numerous experiments have been undertaken with a view to fully testing the claims made for them, especially the degree of communicability. When the culture is fresh and the vitality of the organism is unimpaired a large percentage of the rats eating infected bait sicken and die. Thus far, however, our experiments have not proved that the disease produced by the cultures is contagious. On the contrary, it appears to be limited solely to the individual rodents eating the bait. Hence the cultures appear to possess little or no advantage over mineral or other poisons, the cost of which is much less and the certainty of operation much greater.

GOPHERS.

One of the most destructive of the smaller rodents is the pouched gopher, the various species of which spread from the Mississippi Valley to the Pacific. The animal lives an underground life, feeding mainly on the roots of plants and destroying great quantities of grain and garden stuff. It makes its presence known by throwing up mounds of earth, which cover up grass and other valuable crops. Recently in the Far West the gopher has proved a serious obstacle to the maintenance of dams and embankments of irrigation works by burrowing in them and causing expensive breaks. No animal, however, is more easily controlled by means of traps and poisons. At the request of the Reclamation Service the Biological Survey sent a trained assistant to the Truckee-Carson irrigation project to demonstrate approved methods of trapping, with the result that the animals were practically exterminated along the line of the ditches and are now being controlled with very little trouble and expense.

THE RABBIT PEST.

As in previous years, many complaints of damages by rabbits to orchard trees and to various crops have been received. In a previous report the well-known lime and sulphur wash in general use as a remedy against the San José scale was recommended as a protection against rabbits. A number of orchardists have been requested to give this simple and inexpensive remedy a fair trial. It is being experimented with in different sections, and highly satisfactory reports as to its efficiency have been received; hence its use on a larger scale will be urged. If, as has proved to be the case in several instances, a single application of this inexpensive wash will protect orchard trees against the attacks of rodents for a whole winter, the fact can not be too widely advertised.

GROUND SQUIRRELS.

In the great region west of the Mississippi River ground squirrels are abundant, and in States where grain is extensively cultivated they are exceedingly destructive and annually cause the loss of many thousands of dollars. In California it has lately been discovered that their presence in a community threatens a danger far greater than any pecuniary loss, however large. Recent investigations conducted by the United States Marine-Hospital Service prove that at least one species of ground squirrel is susceptible of plague, and carries the germ of this dread disease, which, as in the case of rats, is communicated to human beings through the agency of fleas. Hence, in regions infested by this particular species of ground squirrel, a crusade against rats alone as the source of plague is not sufficient, but must be supplemented by vigorous measures against ground squirrels. The Beechy ground squirrel, the only species thus far found to be plague-infested, inhabits practically the whole of the agricultural and fruit lands of California from San Francisco Bay to San Diego, and is most abundant in the foothills and coast ranges. East of the Sacramento River it pushes northward as far as Honey Lake. In some localities there are thousands of these animals, and the openings to their underground burrows are only a few feet part. Were they confined to cultivated lands, their extermination over wide districts would be comparatively easy, since the requisite cooperation of individual landowners might be had. Almost everywhere, however, cultivated tracts, whether large or small, are bordered by wild land, especially in the foothills, which serve as nurseries from which farming lands are soon repopulated. To attempt the extermination of this animal over the whole extent of its range would be a gigantic undertaking, probably impossible of achievement, but its numbers may be very greatly reduced and its increase prevented. Experiments with a view to discovering sure and economical means of destroying these animals have already been made by the Survey and will be continued. It is important to use poisons which will, so far as possible, kill the squirrels in their burrows, so that the fleas with which they are infested may not easily reach other animals or human beings.

A bulletin on the subject, containing directions for destroying the animals and accompanied by a map showing definitely the area infested by the Beechy ground squirrel, is in course of preparation and will be widely distributed among farmers and others, especially in the coast districts, where the danger of the infection of squirrels by plague-stricken rats is greatest.

DEER FARMING.

Since earliest times the several members of the deer family—elk, moose, caribou, white-tail and black-tail deer, and others—have been greatly prized. Eagerly pursued for sport, they are highly esteemed for food. Relentless hunting and the rapid encroachment of civilization on the natural breeding grounds of these animals have greatly reduced their numbers, and in certain sections have exterminated them. In most parts of the country venison has ceased to be a common article of food and has become a high-priced luxury. The rearing in confinement of certain members of the family, like the elk and Virginia deer, appears to present scarcely greater obstacles than cattle raising. For the purpose of raising deer for the market their domestication, even their semidomestication, though feasible enough, is not necessary; and one of the greatest advantages of the business is that tracts of unproductive land, when fenced, may be utilized for the purpose, the animals remaining almost in their natural state. It is claimed that there are 250,000,000 acres of land in the United States unfit for general agriculture or for the pasturage of horses, cattle, and sheep, upon which the raising of Angora goats would be profitable. It is thought that a large part of this vast tract, with equal or greater advantage, could be devoted to the growing of venison. The greatest obstacles at present in the way of the successful prosecution of the business of deer farming are State game laws. These, originally framed to protect wild game, require modification so as to permit the sale of live deer for propagating purposes and of venison for food under such regulations of transportation and marking as to fully protect wild game. Here and there individuals have already succeeded in raising both elk and deer on a considerable scale. When once the objects and methods of the business are understood, and game laws are changed to meet the necessary requirements, it is believed that the rearing of venison may be made a commercial success. A Farmers' Bulletin on deer farming has been issued, detailing the results of past experiments, setting forth future possibilities, and explaining the best methods of procedure.

FOX FARMING.

Sooner or later the supply of wild animals which furnish food and raiment for man must be exhausted, because the needs of an expanding population continually increase the demand, and because the natural range of wild animals is constantly being encroached upon by civilization. This statement applies particularly to fur bearers, though perhaps with less force to foxes than to some other animals. While, however, the common red fox is remarkably successful in maintaining existence, even in well-settled districts, the more highly prized varieties, known as silver and black foxes, have become very rare and command a correspondingly high price. As the cost of the better furs places them out of reach of people of moderate means inferior furs are substituted, with the result that the supply even of these is being rapidly reduced and the price correspondingly increased. Under such circumstances the time seems ripe for attempting to rear fur bearers on a commercial scale. Fox raising has already been undertaken by a number of persons with more or less success, according to the location, amount of capital invested, and experience. As the result of recent investigations in the field, supplemented by correspondence, much information on the subject has been obtained, and a Farmers' Bulletin containing the essential details of the business has been issued and is now being distributed. It is believed that in regions suited to the business fox farming may be undertaken by farmers and others with excellent promise of success and that it will yield satisfactory returns for the investment of the necessary capital, time, and labor.

RELATION OF BIRDS TO AGRICULTURE.

Every year witnesses an increase in the number of sportsmen who pursue our game birds, every species of which plays a more or less important part in destroying insect life and preserving the balance of nature; and this, too, while the reclamation of vast tracts of wild land for agricultural and other purposes encroaches on the breeding grounds of game birds, which are thus becoming fewer in numbers, while the demand for them becomes greater and greater. Many of our insectivorous birds also are killed for food, despite the fact that State laws almost everywhere within our borders prohibit such slaughter. With these and other forces making against the welfare of our birds, it becomes doubly important to use every means in our power not only to prevent the reduction of useful species but to increase their numbers whenever and wherever possible.

RELATION OF BIRDS TO THE COTTON BOLL WEEVIL.

As in previous years, investigations were carried on for the purpose of ascertaining what birds habitually eat the boll weevil. Ten additional species were found to feed on the weevil, bringing the number now known to prey on the pest up to 54. A report on the subject—in the nature of a report of progress—has been issued and widely distributed. Though based chiefly on investigations in Louisiana, the recommendations apply equally well to the whole cotton-producing area. As in previous reports, special attention is directed to the birds that feed on the weevil, and their care and protection are urged as the duty of every citizen, whether or not directly interested in the growing of cotton.

RELATION OF BIRDS TO FRUIT RAISING.

An accurate knowledge of the relations of birds to the orchard is peculiarly important that the orchardist may know his friends from his enemies, especially since among the birds that seem to be enemies are some whose services in destroying noxious insects more than compensate for the toll they levy on the fruit. Much attention has been paid to this subject in its relation to the west coast, where the industry of fruit raising is each year becoming more and more important, and the stomachs of more than 600 birds, including many of great economic value, have been examined and the contents determined. The work has been pushed as rapidly as possible, and the second and final part of a report on the birds of California in relation to fruit raising is now nearly ready for the press.

GEOGRAPHIC DISTRIBUTION.

During the year marked progress was made in this branch of the work, and much information was gathered in the field regarding the distribution of trees and shrubs and the distribution, abundance, and habits of our native birds and mammals, which information serves as the basis for constructing the maps of the life and crop zones of the United States.

Work on the life zones of California was pushed with a view to the early publication of a life-zone map of the State, and the southern part is nearly finished. Work was done also in Oregon, North Dakota, Nevada, Arizona, New Mexico, Louisiana, and northern New England, and the results are to be incorporated in a new edition of the life-zone map of the United States now in course of preparation. The biological survey of Colorado was nearly completed, and the map and report on the work are now far advanced.

Revisionary studies of the whitefooted mice and American rabbits were completed and are now ready for publication.

The study of the migrations of birds was continued, and a bulletin was completed on the "Distribution and Migration of North American Shore Birds." This bulletin was prepared with special reference to the needs of legislation respecting this important group of food birds.

GAME PROTECTION AND INTRODUCTION.

The conservation of the birds and mammals of the country is nearly, if not quite, as important to the National welfare as the conservation of any other of its natural resources. Not only do our game birds and animals furnish a food supply of great value, but their pursuit offers a healthful and attractive pastime. Until recently the protection of birds and game has been left to the separate States, but the Biological Survey, by authority of the act of May 25, 1900, and other recent legislation, has been enabled to cooperate largely in this work. Already, with extremely limited appropriations, an influence has been exerted that has borne fruit in greatly improved protection, more effective enforcement of game and bird laws, increase of public interest in the conservation of the native fauna, abolition of the destruction in this country of birds for millinery uses, and decrease of excessive killing of game for market. This should be regarded, however, as merely a promising beginning, and I strongly recommend that the work be placed on a footing commensurate with its importance.

The present means by which the Biological Survey controls or influences bird and game protection are: (1) By supervising bird and game reservations; (2) by supervising interstate commerce in game; (3) by supervising the importation of wild birds and mammals from foreign countries; (4) by cooperating with officials, organizations, and individuals concerned in the protection of game and birds, and

(5) by furnishing information by means of publications and correspondence concerning the preservation of game and birds.

The operations of the year may be briefly summarized as follows:

BIRD RESERVATIONS.

Nine new bird reservations, making a total of 16, were created by Executive order—located off the coasts of Florida, Louisiana, Oregon, and Washington. Wardens were appointed for the Oregon and Washington reservations, and one for the Florida reservations (five in all). The large colonies of birds that frequent these island reservations will in future be protected and may be confidently expected to increase rapidly.

SUPERVISION OF IMPORTATIONS.

The usual careful scrutiny of all consignments of wild birds and mammals imported into the United States was maintained throughout the year. Two mongoose—animals specifically prohibited from entry by the act of May 25, 1900—were refused admission at New York in January, and in February a consignment of song thrushes designed for liberation on Coney Island, and 200 skylarks to be liberated in California were also denied entry, owing to the danger of these European birds becoming pests in this country, as they have in Australia and New Zealand. Birds and mammals are entered principally at New York. Of 103 consignments inspected 99 arrived at that port. It may be noted that the total cost of inspection, by means of which this large country is guarded against the danger of the introduction of animal pests, is less than $1,000.

The number of birds imported into the country continues to grow, and this year reached a total of about 450,000, consisting, as usual, mainly of canaries. The importation of eggs of game birds for propagation shows a decided falling off, the total number brought in being only 714. Especial interest attaches to the importation of European partridges for stocking covers. The number brought over was 7,783, an increase of more than 100 per cent over the importations of the previous year. This apparent growth in popularity of the partridge of Europe as a game bird for America is readily explained by the decrease of two of our own important game birds—the bobwhite and ruffed grouse—both of which have recently suffered severely from climatic vicissitudes.

COOPERATIVE WORK.

The cooperation of the Biological Survey with game officials and organizations is constantly sought, and during the year aid was extended the game officials of California, Idaho, Illinois, North Dakota, Texas, Washington, and Wisconsin.

In my last report mention was made of the prosecution of two noted elk-tusk hunters. The men were convicted at Fort Yellowstone, September 10, 1907, of violation of the Yellowstone Park act, and were sentenced to pay costs of nearly $1,000 and serve a term in jail. This punishment, together with subsequent indictments of the remaining members of the party, has effectually broken up tusk hunting in the vicinity of the Yellowstone National Park.

Through cooperation with county authorities in southern California the spread of the English sparrow to the great fruit-raising section of that part of the State has probably been checked, and after a few small colonies are destroyed it is hoped that the bird can be excluded indefinitely from this region.

INFORMATION.

One of the most important phases of the work consists in the dissemination of information concerning game birds and animals and the steps taken to preserve them. This work is done largely through correspondence, but, in addition, publications are widely distributed containing annual digests of the game laws and other protective measures, or relating to special and important phases of game and bird protection.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

The constantly broadening scope of the investigations conducted by the numerous Bureaus of the Department in response to the urgent demands of the country at large has naturally resulted in a steady and vigorous growth in the amounts appropriated therefor by Congress from year to year. The importance of the Division of Accounts and Disbursements has therefore steadily increased, not only in connection with its function of properly disbursing the Department funds, but also because of the fact that, being charged by law with the administration of the fiscal affairs of the Department in their broadest sense, it is called upon to superintend and direct the preparation of all of the special and annual fiscal reports required by legislative enactment. Among the more important of these reports, already considerable in number, may be mentioned the annual estimates of appropriations, the annual report of expenditures, the annual report of traveling expenses of employees in the District of Columbia, and the comparative three-year report of expenditures.

To carry on the work of the Department of Agriculture during the fiscal year ended June 30, 1908, Congress appropriated the sum of $13,123,040, an increase of $1,940,300 over the preceding year. Of this appropriation $8,537,290 covered the ordinary expenses of the Department, $3,000,000 the permanent annual expense for meat inspection, $1,152,000 the agricultural experiment stations, and $433,750 the printing and binding done under the Public Printer.

The disbursements of the Department for the fiscal year 1908 amounted to $14,148,329.29, and the greater part of the balance of

$668,462.34 will be required for the settlement of outstanding liabilities. The apparent excess of disbursements over the appropriations for this fiscal year is due to unexpended balances, amounting to $1,693,751.63, brought forward from "Administration, etc., Forest Reserves," and other special appropriations.

The amount paid for rent of buildings in the District of Columbia for the several branches of the Department was $65,705.

All accounts for the fiscal year 1906 having been settled, the unexpended balance of appropriations for that year, amounting to $196,619.10, was covered into the Treasury on June 30, 1908. The account for the fiscal year 1907 is still open.

The amount estimated for the fiscal year 1910 in the regular appropriation bill is $14,610,626, which includes $720,000 for agricultural experiment stations. In addition there will be a permanent appropriation of $3,000,000 for meat inspection, a permanent appropriation of $624,000 for additional allotments to agricultural experiment stations under the Adams Act, and $510,000 for printing and binding to be done under the Public Printer, making a grand total of $18,744,626, which is an increase over the fiscal year 1909 of $3,084,520, or 19.7 per cent. Of this increase $2,095,300 is for maintenance and improvements of the National Forests, and the balance, $989,220, is distributed among the other Bureaus and Divisions of the Department.

To sum up the fiscal affairs, it may be added that the principal items of increase each year are for the maintenance and improvement of the National Forests and for carrying into effect the provisions of the food and drugs act. In connection with the expenditures for National Forests, the offset of revenues from the sales of timber and grazing should be taken into consideration. During the fiscal year ended June 30, 1908, these amounted to $1,839,374.92. Since July 1, 1907, these revenues have been deposited in the Treasury to miscellaneous receipts, while prior to that time they were used for the maintenance and improvement of the National Forests, so it will be seen that the National Forests are practically self-supporting.

At the present time the total area of our National Forests is 167,027,319 acres, and the estimated cost of maintenance 2.73 cents per acre, a very small amount when compared with the cost of maintaining forests abroad. France expends annually upon her state forests 95 cents per acre, Switzerland $1.32, Prussia $1.58, and Saxony $2.32. These countries are named because in them the management of the forests is most profitable in products.

In view of the fact that the Congressional Committee on Expenditures in the Department of Agriculture, in its sittings during the last session of the Fifty-ninth Congress, went so thoroughly into the disbursement of the Department for the fiscal year 1906, and found as a result of the examination that every expenditure involved had been properly made, no Congressional inquiry regarding the 1907 expenditures was conducted, although the report of expenditures for that year was prepared as usual by the Department.

DIVISION OF PUBLICATIONS.

During the past fiscal year 1,522 publications were issued, containing 58,510 printed pages. Of these, 477 were new publications, 998 were reprints, and 77 were publications of the Weather Bureau. The total number of copies of all publications printed during the year was 16,875,516. These figures represent but a slight increase over the corresponding figures for 1907. There was, in fact, an actual decrease of 74—or about 14 per cent—in the number of new publications, the increase being entirely in reprints to meet the demands for copies of publications already issued.

By careful revision and condensation, by the elimination of unimportant matter, by checking hasty or ill-advised publications, by cutting out unnecessary illustrations, and by limiting the size of editions, the Division of Publications has sought to promote economy in publication work, and with marked success, as the foregoing figures demonstrate. It should be borne in mind that a saving of printing funds can only be effected by a multitude of small economies, since, in the nature of things, no large economies are possible. Any large curtailment of printed matter would cripple the Department's efforts to educate and enlighten the public. The investigations and experiments made by the scientists and experts of this Department are valuable only as their results are made public; and the reports, bulletins, circulars, and periodicals issued by the Department constitute by far the most satisfactory and effective means of giving these results to the world. It would indeed be idle to spend large sums of money in making important investigations unless full and accurate reports of the same are given wide circulation.

DISTRIBUTION OF FARMERS' BULLETINS.

It is the Department's established policy to make the widest possible free distribution of Farmers' Bulletins, written in simple, popular style and printed in cheap form. During the past year 26 new bulletins were added to the list, bringing the total number in the series up to 327. Of these new bulletins more than three-quarters of a million copies were issued, and the reprints of earlier bulletins, for which there is a strong and steady demand, made the grand total of Farmers' Bulletins issued considerably above 6,000,000 copies.

For many years Congress, in appropriating for the publication of Farmers' Bulletins, has provided that the major part (usually four-fifths) of the copies printed should be allotted to Senators, Representatives, and Delegates for distribution among their constituents. It has invariably happened that some Members of Congress called for only a part of their quotas, leaving the remainder in the document and folding room of the Department. To prevent the accumulation of these unused residues and at the same time to enable the Secretary to place these bulletins where they would serve their intended purpose, Congress, prior to the year 1907, uniformly provided that these unused residues of Congressional quotas should revert to the Secretary for distribution after a fixed date. Under this provision the Secretary was able each year to largely supplement the insufficient supply of Farmers' Bulletins allotted to him.

SALE OF DEPARTMENT PUBLICATIONS.

The year's records of sales of Department publications by the Superintendent of Documents again demonstrated the great popularity of the reports and bulletins of this Department, and the wisdom of providing for their sale and the use of the proceeds in printing additional copies. During the year the Superintendent of Documents sold 94,626 copies of different publications of this Department and received therefor $14,174. The number of copies sold was nearly three times as great as in 1904, and 23,000 more than in 1907. The sales of this Department's publications also exceeded those of all the other Departments combined by about 33,000 copies.

SALE OF ELECTROTYPE PLATES.

It is very gratifying to report that the Public Printer has decided that the agricultural experiment stations, being maintained, in part at least, by the Federal Government, may obtain from him, under the law of January 12, 1895, electrotype plates from the original plates used in printing Department publications at the cost of electrotyping only, 66 cents per page. Under this interpretation of the law the stations can, and no doubt will, frequently procure plates of this Department's publications which contain the results of cooperative work or which may be of special value to them, and will reprint and distribute the same, thus supplementing the distribution made by the Department, which is often very much restricted on account of insufficient funds for printing. If a similar concession could be made to State governments it is quite likely that State officials for agriculture would also reprint many of our publications without expense to us, thus insuring a much wider dissemination of the valuable information in our bulletins than we can otherwise ever hope to secure.

BUREAU OF STATISTICS.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

The International Institute of Agriculture, established under the patronage and through the efforts of the King of Italy in 1905, will be practically organized in the winter of 1908–9. This institute is sustained by forty-six countries, and the membership of the United States is established by the treaty of January 29, 1908. The supreme governing body is the General Assembly, and among the delegates from this country are two representatives from this Department—C. C. Clark, associate statistician of this Bureau, and George K. Holmes, statistical scientist in charge of Investigations of Production and Distribution. The Statistician and Chief of the Bureau, Victor H. Olmsted, has been designated as the representative of the United States for the purpose of supplying information to the institute.

Among the purposes of this institute are the collection, study, and publication of statistical, technical, and economic information concerning farming, both vegetable and animal products, the commerce in such products, and the prices prevailing in the various markets; the ascertainment of the wages paid for farm labor; the publication of information concerning new diseases of vegetables which may appear in any part of the world; the publication of information concerning agricultural cooperation, insurance, and credit; and the submission to the adhering governments of measures for the protection of the common interests of farmers and for the improvement of their condition.

INVESTIGATIONS OF PRODUCTION AND DISTRIBUTION.

The organization of the Bureau of Statistics has undergone a change so far as it relates to the division formerly known as "Foreign Markets," the work of which has become larger in scope. This division is now concerned with Investigations of Production and Distribution. It studies the production of wealth on farms, the distribution of farm products at home and abroad, and the economic conditions pertaining to the agricultural element of the population. The scope and variety of its work are indicated by such subjects as the production and consumption of meat and foreign markets for the national surplus of meat; farmers' cooperative organizations for insuring against loss by fire, for buying supplies, for selling products, etc.; the production and consumption of wheat in the chief countries; the number of domestic animals in most of the countries of the world; the foreign trade of the United States in agricultural products; crop production in many countries; agricultural exports and imports for all countries for which the information is published; the progress and improvement of agriculture in the United States; changes in farm values and the causes therefor, and the transportation of farm products by rail, inland waterways, ocean, and wagon.

THE BUREAU'S PUBLICATIONS AND LIBRARY.

The branch of the Bureau formerly known as the Miscellaneous Division has also been reorganized, and has been named the Editorial Division and Library. This reorganization was made necessary by a notable increase in the number of publications issued from the Bureau; a constant increase in the number of requests, from all classes of the public, for statistical information; and continuous accessions to the Bureau's library of foreign, Federal, State, and municipal statistical literature.

The functions of the division in respect of the Bureau's correspondence have involved extensive and diversified search among statistical and other publications for the purpose of responding to hundreds of requests for varied information concerning foreign and domestic agricultural areas, yields, numbers of farm animals, cost of production, prices of and commerce in agricultural products, fiscal laws relating to commerce and production, migratory movement of farm laborers, use of agricultural products, number of farm implements in use, and divers other phases of the agricultural industry. Compilations have also been made in this division during the year for publication in the Yearbook of statistics of the world's production by countries of corn, wheat, oats, rye, barley, and flaxseed.

The statistical library has now increased to about 10,000 volumes, and, in point of the number of volumes devoted more or less exclusively to statistics of agriculture, is probably exceeded by few similar collections. The bulk of the collection consists of constantly growing sets of annual publications, but a large number of daily, weekly, and monthly foreign and domestic periodicals are also received, either through exchange or through purchase. The library has been rearranged and reclassified, and a thorough revision and wide extension of the card-index system is well under way toward completion. The especial object of this work has been to make easily and quickly accessible the wealth of statistical data relating to the agriculture of the various countries of the world now in possession of the Bureau. The exchanges and trade journals have also been catalogued, so far as statistics of agriculture are concerned, thereby affording prompt access to current statistical literature of the day not available in annual publications.

NEW QUARTERS FOR BUREAU.

e entire Bureau is now assembled in the large hall in the old nistration building vacated by the Department's Library, while fty or more clerks engaged in the compilation and tabulation of the reports of the county, township, and special correspondents used in the preparation of the Bureau's crop reports are concentrated in one room.

CROP CORRESPONDENTS.

The lists of correspondents which the Bureau maintains for the purpose of collecting crop statistics have been improved and augmented by the addition of names of reliable and representative farmers named by Members of Congress from among their constituents, in ready response to requests from the Statistician, while those correspondents who have failed to furnish prompt and full reports have been dropped. These changes have resulted in a material improvement, so that the average number of reports received in time for tabulation had in June increased to over 70 per cent. The lists now include 150,000 active correspondents.

CROP REPORTS ISSUED ON EARLIER DATES.

The monthly crop reports during the year have been published earlier and nearer the dates to which they relate. The reports as to cotton relate to the 25th of the month, and were formerly published on the 3d of the following month; this year their publication on the 1st or 2d has been secured, and it is believed that the date of publication may hereafter be made not later than the 1st of each month. The reports as to grain and other products relate to the 1st of each month, and have been formerly published on the 10th. This year their publication has been made on the 8th or 9th, and it is expected to secure their publication not later than the 7th or 8th of each month. The earlier publication of the reports has been secured by simplifying methods of tabulation and improving the organization of the Bureau.

CROP REPORTING BOARD.

The plan of intrusting the final preparation of reports to a Crop Reporting Board has been continued, and after three full years of trial it has been demonstrated to be an excellent and satisfactory method. It avoids placing all the strain and responsibility on one man, and secures the benefits of consultation and a consensus of judgment among men who have been on the ground.

The Crop Reporting Board is composed of the Chief of Bureau, as chairman, and four other members chosen anew each crop-reporting day from among the statisticians and officials of the Bureau, including special field agents and State statistical agents who are called to Washington for the purpose. The personnel of the board is changed each month. The meetings are held in the office of the Statistician, which is kept locked during the sessions, no one being allowed to enter or leave the room or the Bureau, and all telephones are disconnected.

SPECIAL INVESTIGATIONS.

During the past year the Bureau began the collection of information concerning farmers' cooperative organizations, of which there are an immense number in this country, embracing more than half of the farmers. This undertaking will require several years.

A compilation of the statistics of agricultural imports of the United States, beginning with 1851, was completed. A similar compilation for agricultural exports was made five years ago, and recently the statistics of the reexports of agricultural imports, or the so-called "foreign exports," were compiled for the same period of years, so that the statistics of the entire foreign trade in every agricultural community for more than half a century will soon be made available to the public.

An exhaustive statement of the acreage, production, and foreign trade in tobacco of the American colonies and of the United States from the earliest times to the present year was undertaken and nearly accomplished.

An extensive investigation of the production, trade, and supply of wheat in principal countries was commenced. The plan is to give special attention to conditions in countries which export wheat and to the consumption and markets in the principal importing countries.

A compilation of the statistics of imports of farm products into the Netherlands for the years 1904–1906 was prepared. The quantity of durum wheat exported from the United States in the fiscal year 1907 was ascertained from reports received from correspondents at the leading grain markets and seaports. What is substantially the world's production of wool was ascertained with much difficulty for inclusion in the agricultural statistics of the Yearbook of 1907. This is the first publication of this information by the Department.

STATISTICS OF TOBACCO BY TYPES.

The Bureau is bringing to completion a plan by which it is hoped to secure statistics of tobacco production by types. The State is the smallest unit or geographical division for which the Bureau at present issues detailed reports comparable with similar reports on other products which have been prepared for a long series of years. By the proposed method there can be secured statistics of the amount of each of the different types of tobacco grown in the States where more than one type of tobacco is grown. In the New England States, New York, Pennsylvania, Georgia, Florida, and Wisconsin, where the type of tobacco grown is coextensive with State lines, the amount of each type may be estimated, but in the States of Kentucky, Tennessee, Ohio, Virginia, and the Carolinas, where more than one distinct type grows within the State, it is very difficult to draw a line between counties that produce different types. In order to overcome this handicap this Department has entered into cooperation with the

Treasury Department, through its Bureau of Internal Revenue, which has inserted in the reports made by dealers in leaf tobacco a requirement for a statement of the amount received from farmers. By these data the Bureau will be enabled to check the annual reports and to secure a valuable statement by types.

DEPARTMENT LIBRARY.

The Library has been moved into the basement of the east wing of the new Department building, where it is commodiously housed in 18 rooms, originally designed for laboratory uses. It is of interest to note that at the time of moving the Library contained 100,000 books and pamphlets, whereas when it was first established in the old building in 1868 it contained less than 1,000 volumes. It is also matter for congratulation that this collection of books of such great value to the agricultural interests of the country is now stored in a fireproof building. In the work of preparing catalogue and index cards, and in all other usual lines of work, the Library has had a very successful year.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH THE AGRICULTURAL EXPERIMENT STATIONS.

Twenty years have passed since the Office of Experiment Stations was established to act as a general agency for the promotion of the interests of the agricultural experiment stations, which were then being organized on a National basis in accordance with the provisions of the Hatch Act. Although at the outset that Office had no authority over either the work or the funds of the stations, and even now exercises only a very limited control, it has nevertheless been an important factor in promoting their growth and development. By collecting and disseminating the results of their work, it has done much toward extending their influence throughout this and other countries; by collating the work of similar institutions throughout the world it has brought our stations into close and helpful touch with the whole field of agricultural science; by setting high standards of organization and work, it has led the stations to make constant progress in establishing themselves on firm foundations and increasing the efficiency of their operations; by tactful, yet cordial, criticisms of their work and expenditures, it has done much toward strengthening the weak places and effecting a wise and satisfactory use of the public funds intrusted to the stations.

Its relations with the stations have never been more cordial than they are at present, and its influence never broader nor more potent. The scrutiny which the Office makes of the stations' work as related to their use of Federal funds is now more extended and painstaking than ever before. Since this is made, however, in a helpful spirit, the stations generally recognize that it is calculated to promote their best interests and stimulate them to more thorough work for the benefit of American agriculture.

More than half of the stations were established in 1888 or the previous year as a result of the passage of the Hatch Act, and nearly all of those which had been previously established by the States were reorganized at that time on a broader basis and with greatly increased resources. That year was therefore the beginning of experiment-station work in a National way and on the scale we now know it.

This period has been one of remarkable progress in the development of agriculture as a more rational, enlightened, and progressive industry, and also in the attitude of the farming people toward experimentation and education in agriculture. It has demonstrated the practical value of the experiment station, has shown its fundamental importance in developing a basis for teaching agriculture, and has established it firmly as a public institution.

This period has also been one of experiment in the development of these institutions and in determining what should be their field and function. The demand for practical advice and directions, and for simple tests which it was expected would answer local questions of profit or expediency, was prominent at the outset, and there was frequent disappointment that answers could not be quickly given to questions relating to the whole field of agriculture. The limitations of the fund of reliable information at hand at that time which could be drawn upon for such purposes soon became apparent, as did also the dangers of drawing hasty deductions from superficial tests and short trials. Gradually the public came to realize the need of more substantial and fundamental studies which should deal with the principles and follow more nearly the methods of scientific investigation in order to give results of more permanent value and more general application. As a result of this development of the stations' work, it has come about that the stations, and the colleges with which they are connected, are now in a position to do satisfactorily what they were really forced by circumstances to attempt at the outset, but were unable to accomplish in all cases.

The stations have developed a vast fund of practical information, much of it resting upon a scientific foundation, and have developed their special methods of work. But the dissemination of this information and its demonstration to the farmer have, to some extent, called for a special corps of workers. The supply of competent men to carry on experiments and investigations has never fully equaled the demand, and hence the pressure for their investigations has fixed distinct limits to the time which they could spend in the extension of their work to the farmer. The demand for assistance of a direct nature and the need of various forms of instruction and demonstration have increased year by year. As a result of this condition there has been a sharper differentiation of duties, and the working staff of the station has been relieved, to a large extent, from other forms of activity. Special workers have been provided to look after the teaching work of the college and to do much of the demonstration work and local experimenting, leaving the investigators more largely to their special duties. This broader organization has increased the efficiency of each branch of the work.

The stations are doing more scientific work and at the same time a large amount of practical work. They are carrying their studies more thoroughly over the State and in this way reaching a larger proportion of the farmers and a larger proportion of their problems. The scientific researches inaugurated by the stations under the Adams Act are already pointing, in many instances, to ultimate practical results of fully as great value as those derived from much of the more superficial work and are laying the foundations of the industry broad and deep.

There has been steady progress in the providing of better facilities for the stations and their work. This is true, not only of the buildings which have been provided by the States, but of the equipment which has been furnished and the specially trained men who are being enlisted. These buildings are often among the largest and best which are found on the college campus, and are equipped in a thoroughly modern manner. The States have continued to make increasingly liberal appropriations for maintenance, and in a number of cases have added special farms and branch stations for studying the problems of a section requiring particular attention. These branch stations are at present conducted on a much more efficient basis than the original substations, which sprang up soon after the passage of the Hatch Act. Their work is correlated with that of the central stations, and is supplemented and strengthened by the latter through their laboratory investigations and the expert advice of their specialists. In fully half the States there are at present branch stations of a permanent nature, which serve to extend the work of the stations to different localities and to demonstrate the practical features of their results.

It has been decisively demonstrated that the granting of Federal aid to the States for the maintenance of the stations gave an immediate and tremendous impulse to the organization of these institutions throughout the country and led to increasing liberality on the part of the States in providing for their equipment and maintenance. The latest statistics of the stations gathered by the Office of Experiment Stations show that though the Federal aid to them was greatly augmented by the passage of the Adams Act, the increase in their local funds kept pace with this, so that now more than half the annual income of the stations is derived from sources within the States.

Four hundred and eighty-four station officers do more or less teaching in the colleges with which the stations are connected. During the year the stations published 459 annual reports, bulletins, and circulars, which were supplied to over 774,000 addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins and other special publications, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

The recognition of agriculture as a teachable subject, having educational value comparable to that of any other scientific subject, is no longer confined to the institutions and men whose main work is along agricultural lines. Its recognition and advancement in college and school courses no longer depends solely upon those who might be expected to be prejudiced in its favor. It is now rated with other scientific and technical subjects as a suitable major for the doctorate in philosophy, not only in agricultural colleges and such large universities as Cornell and Wisconsin, where agriculture is regularly taught in undergraduate courses, but also in universities which do not include agriculture among undergraduate courses.

The progress made in agricultural education in the United States during the past eleven years as a result of popular demand stimulated by the work of the State agricultural colleges and experiment stations and of this Department is unprecedented in the history of the world. In 1897, when the present administration of this Department began, all but one of the land-grant colleges were in running order and doing excellent work, but their total income was only $5,000,000; to-day it is almost $15,000,000. The property of these institutions was then valued at $51,000,000; now at $96,000,000. Then there were less than 4,000 students in agricultural courses; now there are over 10,000. Ninety of the 1907 graduates of these courses accepted positions in the agricultural colleges and experiment stations or in this Department at salaries ranging from $500 to $1,700 and averaging $948.66. It is stated by presidents of the agricultural and mechanical colleges that of late the graduates of agricultural courses find remunerative employment much more readily than the graduates from engineering courses.

But the most rapid progress has been made in the field of secondary and elementary education in agriculture. In 1897 Minnesota had the only State agricultural high school and Alabama had just made provision for the last of its nine district agricultural schools. The teaching of agriculture in the public elementary schools was scarcely thought of. To-day there are 15 agricultural high schools of the Minnesota type and 40 other agricultural high schools receiving State
rivately endowed colleges and high schools giving instruction
lture, 115 State and county normal schools preparing young

people to teach agriculture, and, on our lists, over 250 public and private high schools and academies giving some instruction in agriculture. There are 16 institutions offering correspondence and reading courses in agriculture and 26 private or special elementary agricultural schools.

The National Education Association has organized a department of rural and agricultural education and has a standing committee investigating the desirability and feasibility of teaching agriculture in rural schools. The legislature of Massachusetts has created a commission on industrial education, which is giving much encouragement to the establishment of secondary schools of agriculture in the State. The constitution of the new State of Oklahoma requires the teaching of agriculture in all its public schools, and the legislature of the State has provided for four State normal schools with departments of agriculture, and an agricultural high school in each judicial district of the State.

In thirteen States the teaching of agriculture in the rural schools is now required by law. It is encouraged by State and county school officers and taught in some of the rural schools of thirty-one other States and Territories. Forty-four States and outlying possessions, then, are making some effort to teach their youth the underlying principles of our greatest productive industry.

Partly as a result of this remarkable growth of sentiment in favor of secondary and elementary instruction in agriculture in public schools, and partly in response to the stimulus given by the Nelson amendment, allowing the land-grant colleges to devote a part of their increased Federal aid to "the special preparation of instructors for teaching the elements of agriculture and the mechanic arts," about half of these institutions now offer training courses for teachers of agriculture ranging from summer courses of a few weeks to regular four-year courses, with additional graduate work.

This Department is aiding in the promotion of this great movement through all its different Bureaus and Divisions, but the Office of Experiment Stations is giving special attention to it. That Office is cooperating with the Association of American Agricultural Colleges and Experiment Stations, with the National Education Association and other educational associations and their standing committees, and with State and local school officers in the different States and Territories in preparing suggestive courses of study in agriculture, horticulture, and other related subjects, in developing suitable laboratory material and exercises for schools of different grade, and in securing suitable literature to supplement the agricultural text-books and manuals used in the colleges and schools. Many of the publications of this Department are used in this way.

The Director of the Office of Experiment Stations acted as dean of the Graduate School of Agriculture at its third session, as at the other sessions, and has continued to occupy an important position in the councils of different educational associations of National scope. His assistants are regularly engaged in reviewing and abstracting the literature of agricultural education and research from all over the world. At the same time they are selecting and working over such of this material as is suitable for use in the public schools and putting it in usable form for the teachers and pupils.

The Director and his assistants are also called upon to lecture upon methods of teaching agriculture at the Graduate School of Agriculture and at the summer sessions of State universities and State normal schools. One of his assistants this year spent the month of June in a summer school for teachers in Louisiana and July in a similar school in New Jersey. Another gave lectures on methods of teaching agriculture at the Graduate School of Agriculture at Cornell University and at summer schools for teachers at the University of Texas, University of Tennessee, Miami University in Ohio, and Massachusetts Agricultural College. These men are also called upon frequently to attend State meetings of teachers and other large conventions assembled for the consideration of educational problems.

Congress has granted a small additional appropriation for the work of the Office of Experiment Stations in relation to agricultural colleges and schools, which will enable the Office to increase the effectiveness of its organization to some extent, but not in proportion to the rapidly increasing demands made upon it by educational institutions throughout the country. It will not be possible to branch out along new lines, but it is hoped that with the aid and cooperation of other Bureaus of the Department, a beginning may be made in the preparation of two new classes of publications now much needed for the assistance of teachers and pupils in public schools: (1) Instructional publications or brief monographs giving reliable and up-to-date methods of performing certain agricultural operations, such as How to restore humus to the soil, How to prevent soil erosion, How to manage the wood lot, How to get a good stand of corn, How to make and apply Bordeaux mixture, etc., and (2) informational publications, brief monographs concerning the origin, distribution, and importance of leading agricultural crops, and the supply, distribution, and importance of our National agricultural resources. Publications of the first class are needed mainly by the schools in which agriculture is taught, but those of the second class, informational publications, are in demand from all classes of schools, city and rural, to supplement the text-books of geography, botany, zoology, and agriculture.

FARMERS' INSTITUTES.

The farmers' institute has developed until it has become a leading agency in the dissemination of agricultural information. Over 2,000,000 people are reported as having attended the regular institute meetings during the year and 164,000 the special institutes, while there was furnished by State and local authorities $318,000 for carrying on the work. The appropriations represent an increase of $44,000 and the attendance an increase of 415,000 over the previous year.

The growing popularity of this method of instruction is unmistakable evidence of a great desire among farming people for agricultural information, and is also an indication of the way by which this need may ultimately be met. While agricultural bulletins, periodicals, and books have done much to inform farmers respecting improved methods in the treatment of soils, animals, and crops, the absence of an effective agency to call attention to their contents and direct the farmer where to find the information he needs has prevented their being utilized to their fullest extent. The farmers' institute has devoted itself chiefly to selecting the valuable truths of science found in agricultural publications and to showing farmers their practical application in restoring soils, increasing crops, and improving animals. Information respecting agriculture has been accumulating to such an extent and is increasing so rapidly each year that serious attention ought now be given to discovering effective methods for introducing what is known into general practice. This is an immediate need, and the problem will have to be worked out before what has been done in the field of research can be fully utilized by farming people.

In the inauguration of both forms of instruction much remains to be accomplished which can best be done by some central agency acting as a clearing-house to collect, formulate, and disseminate information in ways not within the reach or the province of any local agency. It is in this capacity that the Office of Experiment Stations is working. For both the itinerant instruction and the instruction in schools it is bringing together information, formulating courses of study and plans of organization, and advising with the local officers in charge concerning their own particular plans and problems.

INSULAR STATIONS.

The efforts of the Alaska, Hawaii, and Porto Rico stations along the lines of diversified agriculture have been continued. The Alaska stations devote their principal efforts to live stock, horticultural crops, and cereal growing. The cattle formerly at the Kenai station have been removed to Kodiak and the two herds combined. The station now has about 60 head of registered Galloway cattle, which have demonstrated their ability to withstand winter conditions by going through the last winter without any shelter except an open feeding shed. A larger range is needed for the animal-breeding station, and a survey has been made of a suitable tract. The horticultural investigations at Sitka are quite promising. In the young orchard some of the trees have shown their first blooms, and a few varieties of cherries bore fruit this year. The plant-breeding work is being continued, and as but few varieties of apples have so far shown any indication of surviving Alaskan winters, experiments are being conducted in pollinating some of the most promising varieties with pollen from the native crab apple, and seedlings will be produced as fast as possible. During the past season some of the crosses between the wild and cultivated strawberry and the hybrids between the salmon berry and the cultivated raspberry bore fruit, and selection experiments will be conducted for the establishment of any desirable varieties. A species of willow which is well adapted to basketry has been introduced by the station and was found to grow exceedingly well. The cereal investigations are carried on principally at Rampart and Copper Center, where selections of the earliest ripening heads of every variety are being made. A severe frost again destroyed the grain crop at Copper Center, but at Rampart all varieties yielded well, as has been the case nearly every year since the establishment of the station in 1900. Work was actually begun in developing a station near Fairbanks, reserved for that purpose by executive order, March 22, 1906. About 10 acres were planted to oats and potatoes and arrangements made for clearing more land and for the erection of much-needed buildings. At the Copper Center station plant breeding with native grasses and leguminous plants has been begun, and about 90 species have been brought together for further study.

The Hawaii station continues its work in the diversification of agriculture in those islands. The experiments in shipping tropical fruits have been continued, and it has been demonstrated that pineapples, avocados, and similar fruits may be successfully shipped to any point within thirty days' direct communication with Honolulu. The rice investigations have been continued and extended, and the value of sulphate of ammonia and other high-grade fertilizers when applied to rice has been shown. The results of these experiments have already become well known, and dealers in fertilizers report a marked increase in the sales of high-grade fertilizers to rice growers. The studies in Hawaiian honey made by the entomologist have resulted in the adoption of suggestions whereby a largely increased revenue is obtained by bee keepers. A study has been begun of the insects affecting live stock and suggestions made for the control of some of the more troublesome ones. Among the more promising of the newly developed agricultural industries of Hawaii is pineapple growing, and the study of the soil and fertilizer requirements of this crop has been begun on a comprehensive scale. All the departments of the station will give attention to the problems connected with the cultivation and marketing of this fruit. The introduction of Chinese and Japanese matting rushes has been successfully made and the profitableness of growing these seems to be well established. An experiment in harvesting salt-marsh rice for hay has indicated that large quantities of such hay can be produced in Hawaii to take the place of the hay which is imported, to the amount of $350,000 worth annually, most of it coming from California. The experiments in tapping rubber trees have been continued, and, as showing the possibilities of rubber production, two Ceara rubber trees which had been tapped in July, 1907, when tapped again in January, 1908, yielded 6¼ ounces of dry rubber in nine days. When it is considered that more than 600,000 rubber trees, 90 per cent of which are Ceara rubber, have been planted in Hawaii within the past three years, the importance of experiments in tapping and with coagulants for rubber latex may be appreciated.

The work in Porto Rico consists of experiments in plant and animal introduction and breeding, crop production, control of insect and fungus pests, reforestation, etc. Seedling pineapples and seedling sugar canes, some of which were originated at the station, and improved varieties of other important crops are under observation at the station. Experiments in breeding pigs and poultry have proved quite successful at the station and the surplus is sold to planters at fair prices. No difficulties have been met with in raising any of the improved strains and the demand is always in excess of the station's supply. Experiments in ensiling cane tops for feeding to cattle have indicated the practicability of using this extensive source of forage, most of which is now wasted. Experiments on the reforestation of denuded hilltops are being continued and some varieties of eucalyptus have been found that are well adapted to this purpose. Some of the introduced varieties of coffee are beginning to bear and it is now possible to pass judgment on their qualities. The common Porto Rican coffee has not met with a favorable reception in the continental portions of the United States, and it is believed to be a good policy to introduce the types of coffee which are demanded by the trade. The highly flavored Java coffees seem to retain their well-known characteristics when grown under Porto Rican conditions and coffee planters are taking a deep interest in this experiment and are planting the improved varieties as fast as seedlings can be supplied. The station's suggestions regarding planting, cultivation, pruning, etc., are being quite generally followed on the new plantations. The entomologist has been studying the life history of a number of troublesome insects and has worked out methods for the control of some of them. Parasites of the eggs of the tobacco hornworm, mentioned in the previous report, have been distributed in Porto Rico and also in sections of the mainland. A system of cooperative demonstration experiments has been successfully inaugurated which has proved very popular as a means for the dissemination of information relating to a more rational system of agricultural practice.

Preliminary steps have been taken for the establishment and maintenance of an experiment station in the island of Guam, and the conditions in that island are believed to be favorable for the restoration of agriculture and its development along more modern lines.

NUTRITION INVESTIGATIONS.

According to authority granted by Congress the reconstruction of the respiration calorimeter is proceeding, and reports on investigations made previously are being prepared for publication.

It is expected to take advantage of new features suggested by the work of others or devised by our experts to simplify and improve the respiration calorimeter in several important ways. The work is being rapidly pushed and the apparatus will be ready for use before the end of the fiscal year. Careful plans are being made for the utilization of the apparatus in lines in harmony with the general work of the Department. The investigations planned involve cooperation with other Bureaus and the supplementing, and not the duplicating, of their work, where it concerns the utilization of dairy products, cereal products, and other animal and vegetable foodstuffs produced on farms, on ranches, and in gardens.

With the aid of the respiration calorimeter it is proposed to study the relative ease of digestion of cheese made and cured in different ways, a line of work of the utmost importance in view of the experiments already completed, which have demonstrated the thoroughness of digestion and high nutritive value of cheese as an economical article of diet. It is also proposed to study with the respiration calorimeter the relative value of butter, lard, beef fat, olive oil, and other edible and culinary fats as sources of energy in the body, a matter on which data are much needed in considering problems now before the Department, and to make similar studies needed to round out the Department's work on the food value of cereal products and meat and meat products.

Studies made and in part reported have shown the value of fruits and preserves, evaporated fruits, and other fruit products, and of nuts and nut products, as integral parts of the diet, a matter which is of decided importance to all who are interested in the production of fruits and nuts and the manufacture of fruit and nut products. The respiration calorimeter is essential for the measurement of factors which are at present imperfectly understood.

The estimates for the Department for the next fiscal year include an item for nutrition investigations which is merely sufficient to provide for the immediate management of the respiration calorimeter during experiments and the preparation of popular and technical reports of the investigations made with it. Other expenses necessarily incident to such work will be provided for from funds of other Bureaus which have sought cooperation in this enterprise, provided Congress grants such authority.

The work of the Department in nutrition investigations and kindred lines has a vital relation to the work of our agricultural colleges. In response to a widespread demand among farmers and other people these colleges are conducting courses in home economics in which instruction regarding the nutritive value of different foods and ways of handling and cooking them is an important feature. These colleges have for years looked to the Department for aid in this line and are now doing so more than ever. The agricultural colleges have been stimulated by a recent act of Congress to organize courses for teachers along this line as well as other branches of agriculture and mechanical arts. Secondary and primary schools all over the country are taking up this work and the demand for teachers and for information outruns the supply.

Recognizing the importance of the nutrition investigations of the Department in this connection, students, teachers, investigators, and individuals interested in such problems are turning to the Department in increasing numbers for information and suggestions. This is one phase of the great movement for the improvement of life in both country and city through education directly relating to home interests and the vocations of the people and the dissemination of information along such lines. It has long been understood that work of this character has been undertaken by the Department and the result has been that while we have recently had no funds for nutrition work, the demand for information has continued to increase. It is impossible to satisfy this demand unless funds are supplied for regular work of publication and dissemination of information. The Farmers' Bulletins which we have prepared on the nutritive value of vegetables, fruits, meat, bread, and other subjects relating to the nutrition work have been among the most popular of the series and the editions have run into the hundreds of thousands. These publications should be kept up to date and others prepared to cover subjects not already treated.

IRRIGATION INVESTIGATIONS.

As in the past year, the most pressing needs of the arid regions are practical information for settlers on the large areas now being brought under ditch, and the checking of losses of water in its transportation to the place of use and in its application to fields. In view of this fact work has been concentrated on these two lines. Never before in our history has there been so great activity in the construction of canals and reservoirs to provide a water supply for our arid lands. The construction of these works is under the direction of trained engineers, while the preparation of the land to receive water, which in many cases involves an expense fully as great as for the works which supply the water, is left to the settlers who come almost entirely from sections where irrigation is not practiced and are consequently ignorant of irrigation practice. Realizing that the proper use of water is fully as important as the proper construction of works, we have made a special effort to make available for settlers in the arid region the same degree of expert knowledge regarding the performance of all the operations connected with irrigation that has been used in the construction of irrigation works. This is being accomplished by studying the practice of the older irrigated sections to get the benefits of their experience, and by experiments to get a more exact knowledge of the action of water in the soil and the effect of different methods of applying water and cultivating the soil. To make the results of this work available as soon as possible, many special agents have been employed to assist our regular force of experts. It is estimated that there is now under ditch and awaiting settlement fully 5,000,000 acres. To cultivate these lands will require 100,000 settlers. It is also estimated that each settler must invest at least $1,500 in cash in addition to his labor in establishing himself on a new irrigated farm, calling for an expenditure of $150,000,000, a very large part of which will be wasted if settlers are not given expert advice.

The magnitude of the losses of water in irrigation practice and the importance of checking these losses have been repeatedly mentioned in former reports. Careful observations indicate that not to exceed one-third of the water diverted from streams or stored in reservoirs is actually used by crops in the processes of growth. As the area which can be irrigated is limited by the water supply, not by the extent of available land, any preventable loss is an unnecessary restriction of the irrigated area. Some loss is unavoidable, some can be prevented only at great expense, but much can be done by a better adaptation of methods to the conditions of soil and subsoil without any noticeable increase in present cost. In no other way can so great an additional area be supplied with water at so small an expense. This saving, however, requires an accurate knowledge of the action of water on the soils of different types, and to secure this we are carrying on both tank and field experiments throughout the arid region.

The present activity in the construction of irrigation works in the West has resulted in a large call on this Department for general information as to water resources, water laws, irrigated crops, methods and cost of irrigation, and opportunities for settlement in the various States and Territories of the arid region. This is a legitimate demand and we are preparing to meet it by the publication of a series of brief bulletins giving such information, compiled in most cases by the State or Territorial engineers or by other local officials.

Settlement of the semiarid region by those who expect to engage in dry farming has continued with little check, but the experience of these settlers has increased the demand for information regarding the possibilities of developing small water supplies for the irrigation of limited areas in connection with the farming of large areas without irrigation. The farms established for securing such information and for demonstrating the methods of use and the advantages of irrigation have been maintained during the past year and should be continued. The water for the dry farms on the plains must be pumped from underground sources or stored from storm waters.

The practice of irrigation in the humid parts of our country is becoming more common every year, and the demand for information regarding methods adapted to that section has led to the placing of an experienced man in the East to study conditions and the methods best suited to them. Experiments have been begun for the purpose of testing the adaptation of the cheap western methods to conditions in the East, where the present methods, worked out by the truck growers, are very expensive. The value of the irrigation of meadows and of the use of sewage water on forage crops is being tested by experiment in several localities.

DRAINAGE INVESTIGATIONS.

Recent estimates made by the Department place the total area of unreclaimed wet lands in round numbers at 79,000,000 acres. With reference to their productive value as affected by their natural wet condition, these vast areas may be classified as follows:

(1) Lands which are permanently wet and are never fit for cultivation even during the most favorable years.

(2) Lands which afford pasturage for live stock, though the forage which they produce may be of indifferent quality.

(3) Lands which in their natural condition are subject to periodical overflow by streams, but which at other times produce valuable crops.

(4) Lands which yield profitable crops during seasons of light or medium rainfall, but which are wholly unproductive in seasons characterized by greater than the normal rainfall.

It is estimated that of the first class there are 52,000,000 acres; of the second class, 7,000,000 acres; of the third class, 15,000,000 acres, and of the fourth class, 5,000,000 acres. In addition to this area it is estimated that there are 150,000,000 acres of occupied farm land whose production would be increased 20 per cent, without additional labor in management or cultivation, were it judiciously drained.

The existence of these conditions suggest that immense agricultural possibilities lie before us in the reclamation of the so-called swamp lands, and also in the better drainage of lands which are now under cultivation. That marked attention is being given to this subject by landowners is evinced by the large number of inquiries received by the Department upon matters directly related to agricultural drainage.

The principal localities in which extensive work was carried on during the fiscal year ending June 30, 1908, are enumerated below:

ARKANSAS.—A survey of Camp Bayou near Wilmot, in Ashley County, was made, and plans and estimates were prepared for a system of main drainage ditches adequate for the reclamation of the district. Near Lonoke a small area in the upland-rice district was surveyed and a system of drainage by road ditches was planned designed to facilitate the drainage of the rice lands and improve the roads in that prairie region.

COLORADO.—A preliminary examination of the San Luis Valley was followed by extensive field investigations to determine the feasibility of reclaiming by drainage large areas of land that were once under profitable irrigation, but whose value has been largely destroyed by the accumulation of excessive amounts of water and alkali. A preliminary investigation of the valuable fruit lands of the Grand River Valley which are injured by seepage was also made.

FLORIDA.—A party spent the months from December to April in a continuation of the investigations of the Everglades carried on during the two previous years. All the natural outlets to the Atlantic Ocean, north of Miami, were examined to determine their fitness for improvement sufficient to afford adequate drainage channels for the relief of the Everglades and Lake Okeechobee. A possible route for a canal was located from the head of the Loxahatchee River to the lake, and levels were taken over the line. The lake was entered by going up the Caloosahatchee River, and the north and east shores of the lake were carefully examined.

ILLINOIS.—In cooperation with the Illinois Geological Survey, an investigation was begun of the damage along the Little Wabash River and its tributaries caused by overflow of the rich bottom lands in time of flood, and of the best means of preventing such injury. An investigation was also made of the methods that have been put into use along the Illinois River for protecting and draining the valuable bottom lands by means of an elaborate and expensive system of diking and pumping.

KANSAS.—The investigation of flood conditions along the Neosho River, begun during the previous year, was completed. A plan for the prevention of further injury by overflow of the valuable agricultural bottom lands was developed, consisting of a system of levees extending from Emporia to the Kansas-Oklahoma line. A method of doing the work was outlined and its cost estimated.

LOUISIANA.—A drainage district, including about 15,000 acres in Madison Parish, near Tallulah, was surveyed and plans were prepared for the improvement of the natural drainage channels. The construction of the proposed work is now being undertaken by the landowners interested. The landowners in a similar district near Mounds were assisted in carrying out their survey and preparing their drainage plans.

MINNESOTA.—The laying of nearly 9 miles of tile on the Minnesota Northwest Experiment Farm, at Crookston, was completed in November, 1907. This installation will test, in an experimental way, the effectiveness of tile in latitudes where the ground freezes to a depth of 6 feet or more in winter; also the relative merits in such a situation of cement and clay tile. The cost of all the different operations involved in draining farm lands in this region was carefully determined. A preliminary examination was also made of drainage conditions in McLeod County.

MISSISSIPPI.—Three projects in the Yazoo Delta were investigated. In Tunica County the McKinney Lake District, including 30,000 acres, was surveyed and plans were prepared for its drainage. In Bolivar County the natural channels of 120,000 acres of wet land were examined and recommendations were made for their improvement. Overflow conditions along the upper reaches of the Coldwater River were extensively investigated.

NEBRASKA.—Observations were continued on the tile-drainage experiment near Lexington. In the same neighborhood a survey was made for a proposed drainage district. In May, 1908, an extensive survey was begun of the Logan River to determine the best measures to be undertaken to prevent the extensive injuries to the rich agricultural bottom lands which now occur.

NORTH CAROLINA.—A survey of the Toisnot Swamp, near Wilson, was made and plans were prepared for the improvement of the natural channel sufficient to secure adequate drainage. A drainage survey of a portion of the Angola Bay Swamp, near Burgaw, was made. at the request of the North Carolina Geological and Economic Survey, and plans were prepared for the construction of artificial ditches adequate for the reclamation of the area examined.

OREGON.—A tile-drainage experiment was installed near Albany, Linn County, to determine the effectiveness of under drainage in reclaiming unproductive, wornout wheat lands in Willamette Valley.

SOUTH CAROLINA.—In cooperation with the local landowners, a survey of Sampit Swamp, near Georgetown, was made and plans for the drainage of the swamp were prepared. A survey of the bottom lands subject to injury by overflow along the east side of the Congaree River, below Columbia, was made and plans were prepared for a system of levees to prevent further injury. In cooperation with the authorities of Clemson College, the Office of Experiment Stations assisted in the installation of a tile-drainage system on the Coast Lands Experiment Station Farm, near Summerville, by preparing plans for the system and furnishing an engineer to superintend the construction. This system will serve as an illustration of the value of tile drainage in the heavy coast lands.

SOUTH DAKOTA.—A survey was begun of the overflowed lands lying along the Vermilion River, near Centerville, with the object of determining the best procedure for protecting these lands from further injury.

UTAH.—Observations were continued upon the experimental drainage of irrigated lands in Box Elder, Cache, Weber, Davis, Salt Lake, Sevier, Millard, Emery, and Washington counties. Surveys were made for additional locations where landowners desired to construct drains. The success of the drainage experiments in many places, especially in the northern part of the State, is leading to a large extension of drainage by individual landholders.

Wyoming.—In continuation of work begun in 1903, further investigations were made of the practicability of reclaiming by drainage lands in the Grey Bull Valley which had become injured by excess of water and an accumulation of alkali. In cooperation with the State experiment station, an experimental tile-drainage system was installed on the University stock farm at Laramie. This system will test the efficiency of tile in reclaiming wet and alkalied land, so that it will again be valuable for agricultural purposes.

General technical investigations.—As opportunity offered special studies have been made in several lines in which information is needed by drainage engineers. An investigation was begun of the construction and maintenance and of the carrying capacity of drainage ditches in the southern Mississippi Valley States. Similar data were also collected in Illinois and Iowa. A study of the drainage of peat and turf lands in Indiana, Illinois, Wisconsin, and Minnesota was inaugurated. Studies relating to the reclamation of tide lands along the Atlantic coast from New Jersey to Georgia were carried on.

Dissemination of information.—In addition to the extensive correspondence carried on continuously from the Washington office with inquirers for information on the subject of drainage, various members of the scientific staff made addresses and took part in a considerable number of public meetings held to consider this subject.

OFFICE OF PUBLIC ROADS.

RELATION OF ROADS TO AGRICULTURE.

For many years the Department has endeavored to impress upon producers and consumers the close and intimate relationship of the public road to agriculture, and while endeavoring by practical demonstration and scientific experiment to improve methods of construction and maintenance, has lost no opportunity of awakening the public to a proper appreciation of the great economic importance of road improvement and the necessity for reform in the management of the public roads. Some conception may be had of the immensity of the task by considering the fact that there are 2,151,000 miles of road in the United States, a sufficient length to encircle the globe at the equator with 86 parallel roads. The total expenditure upon roads for 1904 was nearly $80,000,000. At that time about 38,600 miles had been surfaced with stone, 108,200 with gravel, and 6,800 with special materials, making the whole mileage of improved roads only 7.14 per cent of the total. An effort has been made by the engineers of this Department to estimate the mileage of improved roads in 1908, and the total value of all roads, including bridges and rights of way. Taking the 1904 figures as a basis, and assuming that the macadam roads have increased 12.5 per cent, the gravel 15 per cent, and those surfaced with special materials 25 per cent, we have 43,450 miles of macadam, 124,468 of gravel, and 8,512 surfaced with special materials. The cost of the macadam has been estimated at $4,500 per mile, of the gravel at $1,500, and of other surfacing materials at $1,000.

There is about 1,975,000 miles of earth road, which it is estimated has cost for grading, culverts, bridges, and all other items of expense an average of $500 per mile. The right of way, which has been estimated at 40 feet in width for the entire mileage, is worth at the average acreage valuation as given in census reports $342,000,000, making a total estimated cost of $1,720,339,000 for all the roads of this country. Over these roads at least 250,000,000 tons of freight are hauled every year to railroads, not including the immense tonnage hauled to wharves and docks for water shipment, which we are unable to estimate. The data collected by the Department indicate that this hauling is done at an average cost of not less than 23 cents per ton per mile, and that the average haul is about 9 miles, which goes to show that the transportation over the public roads to the railroad represents an annual cost of over half a billion dollars. Hauling in France is done in many cases at as low a cost as 7 cents per ton per mile, and the average there is probably not more than half of the average for the United States. The selling price of farm products is largely determined by factors beyond the control of the farmer. His prosperity must be measured by the margin of profit above the cost of production and of transportation; and it is only when the great agricultural population awakens to a realization that the road problem is a farm problem that we can look for substantial progress in this important branch of transportation.

EFFECT ON EDUCATION.

The relation of the public roads to education is one which has largely been overlooked. It is a more or less well-known fact that we have in all of our States a number of illiterates. While there are a number of contributory causes to illiteracy, it is significant to note that in four States where the average percentage of improved roads is 30.55 the percentage of white illiterates is only 0.34 of 1 per cent of the total population, and in four States in which only 1.51 of the road mileage is improved the per cent of white illiterates is 4.76. It is probable that bad roads are partly a cause and partly an effect of ignorance, but it certainly appears that the two are closely related.

HIGHWAY ENGINEERING.

The demand for men specially qualified in highway engineering is increasing at a rapid rate, and our colleges and universities are realizing that special provision must be made in their engineering departments for this important branch. The usual course in civil engineering does not provide graduates capable of immediately taking up and directing highway work. Accordingly, the Department has cooperated with educational institutions and urged the establishment of courses in highway engineering or the modification of civil engineering courses so as to provide the necessary instruction. The University of Washington has established a chair of highway engineering, to which an engineer of the Office of Public Roads of this Department has been appointed, and many other colleges are now making definite progress along this line. In addition, the Department has for several years successfully carried out a plan of appointing each year a small number of graduates in civil engineering and giving them thorough and practical training in highway work for a period of one year. This is not gratuitous instruction on the part of the Government, as the young men, while receiving a small salary and valuable instruction, are, on the other hand, rendering service to the Government. At the end of one year these students may be retained in the service without further examination and promoted to the position of assistant engineer. The plan has worked out exceedingly well, and a number of young engineers have passed from the Government service to important positions in State and county road work.

SAND-CLAY ROADS.

In many sections of country, almost entirely without road-building rocks, the cost of macadam roads is prohibitive. Sparse population and lack of funds prevent the building of hard roads in many cases. To meet the needs of such localities, the Department has by research and experiment endeavored to devise methods of construction which would utilize to the best advantage the materials immediately available. For many years the sand-clay method has been in successful operation in various Southern States, and the Department has endeavored to bring it more and more into general use. The past summer witnessed the beginning of experiments with the sand-clay method at Englewood, Kans., and later in the summer at Dodge City, Kans. The people at these Kansas points are enthusiastic over the possibilities of the sand-clay road, and at this stage of the work the indications are that the experiment will prove as successful on the Great Plains as in the South. If our hopes are realized in this work, a tremendous benefit will result not only to Kansas, but to many of the trans-Mississippi States.

BURNT-CLAY ROADS.

For several years the Department has been conducting experiments with burnt clay in the Mississippi Delta region. While the experiments have not been uniformly successful, the Department feels justified in announcing that burnt-clay roads are entirely feasible, and under favorable conditions are almost as satisfactory as macadam. A burnt-clay road completed by the Office of Public Roads of this Department at Greenville, Miss., on November 4, 1907, withstood the trying climatic conditions of the winter and spring and an exceedingly heavy traffic, and showed very few signs of damage at the close of the past summer. Another burnt-clay road at Tallulah, La., constructed during the past summer, is now in excellent condition. The burnt-clay road will generally be constructed in sections of country where macadam materials are not available, and in such cases the cost will probably not exceed on the average one-third the cost of the macadam.

DUST PREVENTION.

The destructive effects of automobile traffic on macadam roads have occasioned much uneasiness, as many million dollars have been expended in this form of construction. The engineers of the Department have, in common with others in this country and in France and England, conducted numerous experiments with a view to determining the exact cause of the deterioration of macadam roads and to devising methods of treatment or construction which would effectually meet existing conditions. The materials used in the experiments by the Department have included, among others, tar preparations, asphalt oils, temporary expedients, such as calcium chloride, and several special preparations originated by the Office of Public Roads of this Department. Some measure of success has attended the work thus far, and it is hoped that much progress will be made within the next few years.

INTERNATIONAL BUREAU OF ROADS.

So important has the subject of road improvement become that an international road congress has just concluded its deliberations at Paris, France, which was participated in by the representatives of 29 governments, and at which nearly 100 valuable papers on various phases of the subject were presented. The most important outcome of this congress was the formation of an international bureau of roads, to be composed of two or more delegates from each of the governments represented at the congress. The purpose of this bureau is to collect and make available for all of its members all data of importance on the subject of roads in every country. It is gratifying to be able to state that the suggestion for such a bureau was made by the chairman of the commission representing the United States Government, and that it was unanimously adopted by the congress.

TESTING OF ROAD MATERIALS.

The testing of road materials to determine their suitability for road building has reached a high state of efficiency in this Department, and it is a cause for much gratification that the work which is being done by the road-material laboratory is regarded in England, and by many authorities in other European countries, as being further advanced and more effective than similar work done in any other government laboratory in the world. So highly is this work regarded by the chief highway officers in England that a request has been made to the Department to test some of the characteristic road-building materials of Great Britain.

In the borough of Hornsey, in England, it has been ascertained that a number of sections of exceptionally good roads have been constructed by the mixing of limestone and siliceous rocks in accordance with suggestions contained in publications of this Department setting forth the results of experiments in the mixing of these materials, whereby the cementing value is increased beyond that of either material alone, thus making possible the use of many crystalline rocks of low cementing value and of low cost.

OBJECT-LESSON ROADS.

Measured by comparison with previous years' results, the object-lesson work of the past year was the most successful in the history of the Department. At the close of the year 31 object-lesson and experimental roads had been completed, or were in course of construction, illustrating the best methods of road construction as adapted to conditions in each section of the United States. These object-lesson roads were instrumental in the giving of instruction in the art of road building, and it may therefore be said without exaggeration that the Department maintained 31 temporary schools in road building.

The engineers from the office made the necessary surveys and prepared the plans and estimates and supervised the construction, instructing the local road builders at each stage of the work. In all, 10 macadam, 6 sand-clay, 4 gravel, 3 earth, 3 burnt-clay, 1 shell, 2 tarred, and 2 oiled roads were constructed, making a total of 223,208 square yards of road surfaced. Object-lesson and experimental roads were constructed in Massachusetts, Virginia, West Virginia, South Carolina, Kentucky, Tennessee, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Wisconsin, Missouri, Arkansas, North Dakota, Nebraska, and California during the year.

UTILIZATION OF BY-PRODUCTS.

Approximately 20,000,000 tons of blast-furnace slag are produced annually in the United States, most of which is a total waste. Slag has been used very slightly as a road-building material, for the reason that it is exceedingly difficult to maintain a well-bonded surface. The Office has, during the past year, inaugurated experiments in the building of roads of slag in combination with tar and asphalt preparations along original lines. It is hoped that these experiments will not only open the way for a more general use of slag as a road material, but that the addition of bituminous binders will result in much progress in the development of dustless roads.

Some interesting experiments which have not yet progressed to a point where definite results can be anticipated have had for their object the utilization of the by-product of the beet and cane sugar refineries which, at present, has very little commercial value. This by-product is a thick sirupy liquid which remains after the various grades of sugar and of molasses of commercial value and alcohol have been obtained.

ROAD CONSTRUCTION, ADMINISTRATION, AND MAINTENANCE IN FOREIGN COUNTRIES.

Early in the past summer a list of questions was prepared in this Office which the State Department transmitted with a letter of instructions to the American consuls in every foreign country. Copies of the replies are being forwarded to the Department of Agriculture by the State Department, and it is probable that within a comparatively short time complete and interesting data will be available for the American public concerning all phases of the road subject in every foreign country.

At the same time an investigation is being arranged through correspondents in each county in the United States whereby complete information concerning roads, road revenues, and expenditures for this country will soon be available.

CORROSION OF IRON AND STEEL.

This investigation was begun for the purpose of determining the cause of corrosion of metal road culverts, and to discover if possible the means of preventing or minimizing the corrosion. Investigation thus far has produced data of great scientific and practical value, which are set forth in publications issued by this Department. The results of the work have already proved of great benefit, as several of the rolling mills have materially modified their methods of manufacture to conform to the conditions indicated as essential in the results of the investigations.

During the past summer test fences were erected at Pittsburg and Atlantic City, and at the latter place a number of large plates of steel were set up in frames facing the ocean. These plates were painted with standard pigments and with pigments prepared according to specifications drawn up in the Office of Public Roads. The purpose of this test is to determine the relative merit of the pigments used in the prevention of rust.

TRACTION TESTS.

At the close of the past fiscal year arrangements were made for conducting during the current year a series of thorough traction tests to determine the tractive resistance of various road surfaces and grades and various widths of tire. Much instructive and interesting information should result from them.

GENERAL ADVISORY WORK.

The demands upon the Department for expert advice on road construction and maintenance have grown continuously in recent years, both in volume and in complexity. The result has been that a corps of consulting highway engineers of the widest possible experience and adaptability has grown up in the Office of Public Roads, supplemented by specialists in the various methods of road construction and in the various lines of experiment.

Considering the year as a whole, it is within the bounds of conservatism to say that far greater results have been accomplished than in any preceding year, and that the status of road work in general throughout the United States is more advanced and more promising for future development than in any year since the settlement of North America by the white man.

REVIEW OF TWELVE YEARS.

In presenting an account of the work of the Department it may be worth while to survey the last twelve years of endeavors, and of their fruition and promise, to which not only this Department has contributed, but also the experiment stations, the agricultural schools and colleges, the State boards and commissioners, the agricultural press, and the farmers themselves in their individual and collective efforts.

Momentous changes have occurred to agriculture in this country during the last dozen years. Features of great import have been introduced. Forces have become operative whose results are already enormous, with the certainty of cumulative and accelerated future consequences for the Nation's good and well-being. The farmer's work and harvest have had the benefit of more varied knowledge and more effective intelligence. His life and living have undergone transformations which increasingly make the farm preferable to the town.

IMPROVED FINANCIAL CONDITIONS.

This period has developed an amazing and unexampled prosperity for the farmer. His improving financial condition has been both an effect and a cause—an effect partly of his own efforts joined to those of public agencies, and also the means of making his life and the lives of his wife and children the better worth living.

More wealth has been invested in improving the farm home and in the current expense of farm life. With better houses filled with modern conveniences, the family life has developed in strength and in enjoyable living. Through the introduction of machinery, the betterment of buildings and appliances, and the improvement of methods the farmer's labor is rapidly becoming less in physical stress, and the burdens of the household are becoming lighter. Child life on the farm is entering upon a realm of favoring conditions in the home, at school, and in farming, and home-making apprenticeship is rising to a higher level.

CHANGE FROM LOW TO PROFITABLE PRICES.

The year 1897 or thereabouts marked the farmer's financial turning point. The prices of his products had previously often been below the cost of production, and he occupied a weak position as a seller. Within a very few years thereafter prices had risen so as to make him strong as a seller and to enable him to hold his crops for fair prices.

Corn was worth but 21.5 cents a bushel at the farm December 1, 1896, as an average for the United States, and less than that in the great corn States. By 1900 the price had risen to 35.7 cents, and the November price of this year is 63.5 cents.

Wheat sold for as little as the average of 49.1 cents a bushel December 1, 1894; a marked increase to 69.5 cents favored the crop of 1903, and now the November price is 91.5 cents.

The farmers and planters of the cotton States were in a wretched financial condition when the cotton crop of 1894 was sold for 4.6 cents a pound. Their independence began with the price of 11.66 cents in 1903. During the last six years the mean price of cotton to the growers has been 9.865 cents and the seed has brought them many millions of dollars annually.

Hay was worth at the farm only $6 a ton in 1898; the price rose to $10.01 in 1901, to $11.68 in 1907, and it was $9.22 on November 1 of this year. The farm price of oats was at the low figure of 18.7 cents a bushel in 1896; in 1901 it was 39.9 cents; in November, this year, 46.5 cents. Barley was sold for 32.3 cents in 1896, 45.9 cents in 1902, 66.6 cents in 1907, and 53.7 cents in November, 1908. Rye was at the low price of 40.9 cents a bushel in 1896; in 1901 the price was 55.7 cents; in November, 1908, 73.7 cents.

Tobacco was not worth raising at the average price of 6 cents a pound in 1896; there was some improvement with 8.1 cents in 1904; still more with 10.9 cents in 1907; and perhaps a higher price this year. In 1896 potatoes brought 26.6 cents a bushel to the farmer; the rise was to 76.7 cents in 1901 and to 69.2 cents in November, 1908.

In the meantime the prices of domestic animals had participated in the forward movement. Horses of all ages had the average value of only $31.51 at the farm January 1, 1897. The average was $52.86 in 1901 and $93.41 in 1908. From the low price of $41.66 per mule in 1897, all ages included, the figure rose to $63.97 in 1901 and to $107.76 in 1908.

The farm price of dairy cows has gone from $21.40 in 1892 to $27.45 in 1898, and to $30.67 in 1908; of all other cattle of all ages, from $14.06 in 1895 to $20.92 in 1898, and to $16.89 in 1908.

A remarkable change in price was in that of sheep, from $1.58 in 1895, all ages included, to $2.46 in 1898 and $3.88 in 1908. Hogs had the low price of $4.10 per head January 1, 1897; the average was $5 in 1900, $7.62 in 1907, and $6.05 in 1908.

The consequences of such rises of prices need not be itemized. The old cotton plantation that no lender wanted as a mortgage security is now sought for investment and its owner can borrow without mortgaging. The farmers of the mortgage-ridden Kansas of former days have stuffed the banks of that State full of money, have organized banks of their own, and have sent money to the East to invest.

AGRICULTURAL SCIENCE.

Relieved of the weight of debt and of suffering under unprofitable prices, the farmer felt more responsive than before to the help offered by the Department of Agriculture, the experiment stations, and other sources during the period under review. Thousands of learned investigators worked for him. Thousands more talked to him repeatedly. Thousands of demonstrations taught how to do by doing. Many boys were educated in agriculture. Hundreds of millions of copies of publications were sent broadcast. The story of what was done by Nation, State, and private persons can here be stated only briefly.

PLANT AND ANIMAL BREEDING.

Both the science of breeding plants and animals and practical methods have made remarkable advance. During the past dozen years breeding has passed the unorganized stage and has come under the domain of science. Rapid advances are being made in the study of the laws under which heredity operates. The exceedingly great value of the rare mutating plant or animal which has the power to project its unusual individual values into its progeny and thus produce a valuable new strain has come to be appreciated as the most important source of creative breeding.

The public scientist and the cooperating groups of breeders and growers of pure-bred seeds, plants, and animals are organizing State breeding establishments, where large numbers of plants and animals can be brought under performance. The wheat breeder by working out methods of testing and recording breeding values has assisted the animal breeder.

DEFINITE RESULTS WITH PLANTS.

The breeding of types of Sea Island cotton immune to various diseases; the securing of types of nitrogen-gathering plants to use in rotation with such kinds of cotton; improvements of the fiber of other kinds of cotton and of its productivity; the marked increase in corn production due to knowledge of the laws governing corn breeding; the establishment of important tobacco industries, such as the growing of the Sumatra wrapper leaf and the Cuban filler through adaptation to proper conditions, and the creation of desired strains by breeding; the securing of a whole series of hardy citrus fruits; improvements in wheat and oats—these are some of the grand achievements of plant breeders. These words are few, but the millions of dollars created annually by reason of the work of these men are many.

In one State this Department and the experiment station jointly spend less than $20,000 annually in conducting a plant-breeding establishment, and half a dozen varieties of newly bred field crops have been distributed which added this year $2,000,000 to the value of the same crops as raised in former years, because of their improved heredity.

Hybridization and seed selection in the case of existing crops have been performed scientifically to produce varieties to meet new conditions, to produce larger yields, to resist cold, drought, and disease. With the advent of the cotton boll weevil, the breeding of cottons fitted to escape weevil injury, to produce longer staple and heavier yields, and to resist wilt, root rot, and other diseases, was undertaken with gratifying results. Several entirely new cotton hybrids have been developed which possess great improvement over former varieties. This Department's newly bred, heavy-yielding, long-staple Upland cotton, the Columbia, received a gold medal at the Jamestown Exposition.

The wilt-infested cotton soils of the Southeast have been outwitted by the breeder of wilt-resistant varieties of both Sea Island and

Upland cotton. The breeder has hastened the maturing of cotton to insure the safety of the crop upon the arrival of the boll weevil. Varieties of Guatemala cottons have been introduced and acclimatized because they have characteristics that enable them to resist the boll weevil. Egyptian cotton has been introduced, acclimatized, and established in the Colorado Valley in Arizona and California.

Good progress has been made in breeding single-germ seed balls, which will greatly reduce the labor and cost of growing sugar beets. High-grade sugar-beet seed, fully equal to the best imported, has been bred in this country.

Among the results of breeding tobacco for quality, uniformity, and yield are the Uncle Sam Sumatra, the Hazlewood Cuban, the Brewer Hybrid, and several other improved types which have been disseminated and which give an increased yield of 50 to 75 per cent of great uniformity and high quality.

Corn-breeding methods have developed varieties whose yield is 15 to 25 per cent above that secured by the best of the former varieties. This Department has introduced from Guatemala for breeding purposes new types of corn adapted for growth in the moist Gulf regions and other varieties for growth in the hot arid regions. The development of quick-maturing, high-yielding dent corn for the northern edge of the corn belt has been accomplished by the experts of the Department.

The corn plant is very pliable in the hands of skillful breeders. Ten generations of breeding at the Illinois station have increased the average protein content from 10.92 per cent to 14.26 per cent, and also have decreased it to 8.64 per cent; the average oil content has been increased from 4.70 per cent to 7.37 per cent and diminished to 2.66 per cent.

Seed-corn breeders' associations now exist in most of the States of the corn belt. Seed corn is now largely grown as a special crop. Pure strains are being developed, new varieties originated, and older ones improved.

The Florida sweet orange has been hybridized with the cold-resistant trifoliate orange and several new strains with greatly increased hardiness have been developed, so that the orange-producing area has been much enlarged. From these hybrids it is expected that citrus fruits of great value will eventually be grown throughout the Southern States.

At the Colorado Experiment Station a cantaloupe has been bred that is resistant to the rust fungus. In South Dakota the third generation of seedlings of the native sand cherry produce fruits 1 inch in diameter and of good quality. Native Dakota plums and sand cherries have been hybridized with other stone fruits from Europe and Asia to combine the hardiness of the native fruits with the size and quality, to some extent at least, of the choice cultivated fruits from abroad. In New Jersey practically all of the important vegetables have been subjected to hybridizing and breeding, and many new varieties with desirable qualities have been produced and disseminated.

Good varieties of wheat have been originated by breeding. The Minnesota station originated numerous varieties, two of which have spread over half a million acres, and yield from 1 to 3 bushels more per acre than the varieties formerly grown. The Maryland and Michigan stations bred new varieties of wheat, which are now grown in those States. The winter-wheat belt has been extended farther and farther north by sowing adapted varieties until it is now grown in regions which had before been regarded as incapable of growing it. Winter character has been added to the spring wheats of the Pacific coast and new hybrids of these wheats are now grown there.

Methods of growing winter oats successfully in Southern States have been developed of late by some of the southern experiment stations and varieties of oats adapted to winter culture have been distributed. The Wisconsin station improved the Swedish Select oats and 5,000,000 bushels of this variety are now grown by Wisconsin farmers.

The Minnesota station originated and disseminated a promising variety of flax for seed production, and the North Dakota station achieved great success in combating the wilt disease of flax by treating the seed and by developing resistant strains.

NEW STRAINS OF FARM ANIMALS.

The Department has begun experiments to ascertain the effects of close breeding. Cooperation of the Department with State stations and farmers has begun to create new strains of farm animals—carriage horses, in Colorado; cattle for beef production under southern conditions, in Alabama; the cross of the horse and the zebra, in Maryland; the reestablishment of the Morgan breed of horses, in Vermont; sheep especially suited to range conditions, in Wyoming; a breed of milking Shorthorn cattle, in Minnesota; draft horses, in Iowa; improved Holstein cattle, in North Dakota; a breed of hens for high egg production, in Maine.

INTRODUCTIONS.

Trained explorers are constantly traversing foreign and remote lands in search of promising seeds and plants for trial and possible introduction into the United States, and from this one feature of the Department's work many millions of dollars are added yearly to our national production of wealth.

DURUM WHEAT, RICE, AND BEETS.

From Russia and Africa durum wheat was brought during 1899 to 1902, and thus was laid the foundation of the great crop of this special kind of wheat in this country, which amounted to 45,000,000 bushels in 1907, worth $30,000,000 to the farmers, and providing exports of 22,000,000 bushels. The rice growers of the Gulf coast received superior varieties from the Orient, which have greatly increased the value of the American rice crop and given to it a firmer basis.

Sugar-beet growing for producing sugar had hardly become established in 1897, and the production of that year was only 45,246 short tons of sugar. Since that time this crop has been introduced into new parts of the sugar-beet belt, with the result that the crop of this year amounts to nearly 500,000 tons of sugar, worth $45,000,000.

ALFALFA AND WINTER WHEAT.

So immense has become the production of alfalfa, an introduced plant, that attempts to estimate its quantity and value fail. It is supposed that this year's alfalfa hay is worth $100,000,000. This is the great forage plant and soil renovator of a vast area in the Rocky Mountain and Pacific coast regions. Its growth is extending eastward, and it has become generally established as far east as the longitude of eastern Kansas, and it is partly or fully established in spots throughout the North Central States, in the limestone regions of Kentucky and Tennessee, and in a less degree in the North Atlantic States. Several cold and drought-resistant strains of alfalfa have been introduced, including an oasis alfalfa from the Sahara, resistant to alkali; various types of Turkestan alfalfa, resistant to drought; Siberian alfalfa, resistant to cold; the sand lucern, a north European variety, very resistant to cold; Arabian alfalfa, resistant to drought; Peruvian and Chilean alfalfas, suitable for culture in the Southwest.

New varieties of hard winter wheat have been introduced which have been mostly instrumental in extending the winter-wheat districts over 200 miles farther north and west, and which give an average yield of 5 bushels per acre more than the spring sorts.

CONTINUED ADDITIONS.

The Swedish Select, the Tobsk, and the Sixty-day oats have been introduced and have proved of far greater value than former local varieties in the North and Northwest.

A variety of soy bean has been introduced from central China, suitable for becoming a cover crop for rice lands and greatly needed by the rice growers of the Southern States.

The best varieties of the date palm, the offspring of the oasis of the Algerian Sahara, have been introduced and established in the Southwest. The dry-land olive has been successfully introduced into Arizona and southern California.

The value of the prickly pear as a forage plant has been demonstrated, and this plant is now grown under cultivation and bids fair to render agriculture practical in regions where the rainfall is too intermittent to permit the growing of ordinary crops.

The discovery of a simple method of extracting camphor from twigs and leaves and the demonstration that American-grown trees contain a high grade of camphor have enabled this Department to begin the establishment of a camphor-growing industry in Florida.

The basic thought underlying plant introduction has been home production in place of importations, the production of wealth and the diversification of products within the Nation in place of dependence upon foreign agriculture.

FARM MANAGEMENT.

The State experiment stations, the colleges of agriculture, and the Department are placing the subject of managing the farm on a scientific engineering basis. The planning of a new farm or recasting the field plan of the old farm are being reduced to such form that they are profitably taught in agricultural schools. A number of the experiment stations have determined the kinds of crop rotations which yield the largest net returns for given soils and agricultural districts. Numerous long-time experiments on State and branch experiment station farms controlled by the Department are under way to determine those crop rotations and other methods of internal management of the farm which will be most profitable and best adapted to the family and other available labor.

In cooperation with the Minnesota Experiment Station a method has been developed of securing under average actual farm conditions the cost of each farm operation and of each crop, animal, or other product. By using these figures of cost per acre and per unit of product, and of the crop or other resulting product, a system of simplified farm accounting and cost keeping has been devised. The most novel part of this system of teaching farm management is farm maps, which serve in such a simple and convenient manner as an annual ledger of crop production cost and net income that farmers can easily use it.

Extensive studies are made of the best practices of successful farmers in all parts of the country. Demonstration of the wisdom of doing things in prescribed ways by calling attention to desirable results; plans of farm management that raise the income per acre from a paltry sum to a very profitable one; instruction in farm practices in hundreds of particulars, the success of which is readily understood in terms of profitable income—these are lines of work which have been followed and have produced widespread diffusion of agricultural knowledge and improvement.

DEMONSTRATION WORK.

The boll-weevil territory affords a notable example. In 1904 the Department inaugurated on a small scale what is now known as its "Farmers' Cooperative Demonstration Work." The initial efforts met with such emphatic success that the work has been gradually increased until now the whole cotton belt and many outlying regions are covered by a large force of trained field agents, all practical farmers. These men are wielding a wonderful influence among the farmers of the South to adopt better cultural methods, to use improved seed, and thus to increase their profits.

Striking proof of the success of this work is that the results have attracted so much attention that voluntary private contributions toward its extension have almost reached the total amount appropriated by Congress for its maintenance. Large districts which had been almost deserted on account of the boll weevil are now more prosperous than at any time in their history, and many men who have been renters are buying land and raising cotton profitably as a result of better systems of management.

Closely related to this work are the farm management investigations of the Department, consisting primarily of a detailed study of the practices followed on the most successful farms in well-defined communities, and the application or adaptation of these practices to other and less prosperous farms throughout the country. The aim in all this work is to bring the farm up to its maximum producing power through systematic management, both as to cultural practices and as to business methods.

Along this line of work important progress has been made in aiding the farmer to put into practice results of scientific discovery. Methods of storing the soil with humus without interfering with established cropping systems have been taught, especially to the farmers of the cotton States, who keep comparatively little live stock. The production of hay in the South has increased greatly where this work has reached. Improved crop rotations have been devised and put into practice. The principles involved in planning cropping systems on live-stock farms have been applied. Studies of weeds have resulted in discoveries that enable the farmer to destroy such serious pests as Johnson grass and quack grass at comparatively little expense.

A practice highly important to the corn crop, that of shallow cultivation, has become prevalent in the corn belt and is growing in favor elsewhere; this counts for increased yield. In wheat culture, early plowing and thorough preparation of the seed bed are much more extensively practiced than formerly.

DRY FARMING.

Dry farming has come to be recognized as an important factor in our future agricultural progress. Much useful information has been accumulated to determine the conditions under which crops may be successfully grown, the best systems of crop rotation, and the tillage required for the conservation of soil moisture to adapt new crops to the dry regions. It seems probable that as a part of this work and of the reclamation projects, a half billion acres of dry and arid land will be made available for agriculture in the course of time. The last ten years have witnessed a remarkable exodus of people from the eastern parts of the country to the western, especially to the dry part of the Great Plains. This vast region, formerly considered of little use for cultivation, is rapidly becoming one of considerable agricultural importance under the guidance of the Department and State experiment stations.

SOILS AND THEIR TREATMENT.

Soil surveying was begun by this Department nine years ago. The reason for this work is the fact that each variety or strain of crop produces its best in some certain soil and climate, and that for each soil and climatic condition there are crop rotation and farm-management schemes which pay best. The object of the survey, therefore, has been to find the proper soil for the crop, the proper crop for the soil, and to aid in devising scientific engineering plans for the management of farms on each class of soil and in each agricultural region. The survey has now covered 150,000 square miles in all parts of the United States, a larger area than the total land area of Great Britain and Ireland, or of Japan. It has led to the growing of special types of tobacco in the Gulf States, it has made marked progress in the standardization of soil descriptions, and it has brought close cooperation between the National Government and various States.

In the course of this survey the alkali problem has been solved. The rise of alkali to the surface had caused the abandonment of wide areas of land in the belief that when once it has appeared no further use can be made of such lands. The Department has demonstrated in widely separated districts in the arid West that the reclamation of areas unproductive on account of the presence of alkali is both feasible and economical.

Much attention has been given to the study of soil bacteriology, and improved strains of nitrogen-fixing bacteria have been developed and widely disseminated and have proved highly useful in the inoculation of the various leguminous crops to increase their accumulation of nitrogen.

Instruction in the conservation of the soil and its fertility by all available means has been incessantly carried on by the Department, the experiment stations, agricultural colleges, and by private publications. The importance of the cover crop to prevent winter erosion and to hold the humus and fertile elements of the soil for the benefit of succeeding crops has been one of the most emphatic teachings and has been prominent in every plan of crop rotation and farm management. The utilization of leguminous plants for enriching the soil, such as alfalfa, clover, and cowpeas, has been much extended throughout the country. So great has been the demand for cowpea, velvet bean, and crimson clover seed in the South that the farmers have been unable during the last two years to secure a sufficient quantity, even at very high prices.

VEGETABLE PATHOLOGY.

Plant diseases have been suppressed and avoided during the period under review in a far greater degree than ever before. A true science of plant pathology has been founded and the discovery of the causes and treatment of diseases has led to many improvements in mechanical methods of utilizing fungicides. Still greater advances have been made in the direction of plant sanitation, and improvements in the environment of plants as well as in the plants themselves have increased production, both in quantity and in quality. No part of the work of the Department and the experiment stations yields a more direct cash return than this.

OVERCOMING AND AVOIDING PLANT DISEASES.

A method of spraying trees has been devised which effectively prevents the bitter rot of apples, a disease which has caused in one year a loss of over $10,000,000.

A simple and effective method of preventing peach-leaf curl has been discovered which already saves hundreds of thousands of dollars annually. The peach-twig blight or gum disease of the peach, in California, is a disease which caused great loss of peaches in that State, but a method for its control has been discovered. The nature and method of control of the disease known as "little peach," which has threatened to destroy the peach industry of Michigan and western New York, has been determined. A method of controlling the pear blight, a disease which has destroyed the best varieties of pears in many parts of the country, including $5,000,000 worth of orchards in California, has become effective.

A new spray—self-boiled lime-sulphur—has been discovered which may be safely used in spraying peaches for the control of the brown rot, a disease which has destroyed annually from 15 to 30 per cent of the peach crop. This mixture is also a valuable general spray, as an insecticide, and is effective in the treatment of San José scale.

Among numerous discoveries are the causes and the methods of control of the brown rot of cabbage, turnip, potato, tomato, and egg plant, and of numerous other bacterial diseases of crops; the withertip and orange blight of citrus fruits, two diseases which have caused great loss; and the cranberry scald and rot, causes of heavy losses. The cause of wilt disease of watermelon and cowpea has been determined and the disease has been avoided by the introduction and development of resistant varieties of these crops where old varieties will not grow.

Investigation of the causes of decay of timbers and the methods of preventing it has resulted in improved methods of handling timbers and in impregnating them with protective substances. A cheap and effective method has been discovered for treating fence posts to prevent decay.

INSECT PESTS.

Most civilized nations have quarantine regulations to exclude insect pests, and the United States is the only exception of prominence, but in this country the subject of remedies against this class of insects has received the greatest attention. The perfection of the lime-sulphur-salt wash has practically solved the San José scale problem, and recent investigations by the Department as to the use of hydrocyanic-acid gas against scale insects on citrus trees have been so successful as to promise the saving of a large number of orchards of great value.

PREVENTION OF DAMAGE.

The discovery of the original home of the San José scale in China by a learned expert of the Department and the introduction of its natural enemy into this country was an achievement of note, but the economical use of sprays has rendered the attempted establishment of the natural enemy a matter of comparatively slight importance. The tremendous effect of the spread of the San José scale was beginning to be realized twelve years ago, but in the meantime the efforts of this Department and of the experiment stations have enabled fruit growers to save their trees from this insect.

Much has been done in practically utilizing the natural enemies of injurious insects and in introducing into the United States beneficial insects of one kind or another. This Department has introduced into California the fig-caprifying insect, which has established a strong Smyrna-fig growing and packing industry. Parasites of the gipsy moth and of the brown-tail moth have been introduced which bid fair to relieve New England from the present danger to orchards and forests, and the rest of the United States from prospective danger.

Hawaii has introduced natural enemies of the sugar-cane leafhopper, which have relieved the sugar-cane crop of that territory from an immense burden. Successful experiments for handling the parasites of the Hessian fly promise to be of great value to the wheat farmer. An egg parasite of the imported elm leaf-beetle has been brought from Europe.

Within the period under review studies of the cattle tick and its allies have resulted in developing a system of cultural rotation which enables cattlemen in tick-infested localities to rid their land of ticks by a simple and effective process, and a movement under Federal auspices promises to result in the eradication of this insect.

Great discoveries of enormous value to the health of the people have been made in investigations carried on concerning the life history of malaria and yellow fever mosquitoes and of the typhoid fly, and concerning the causes of the widespread hook-worm disease and remedies therefor. Measures founded upon these discoveries can readily be taken, and this will result in freeing large regions from some diseases.

In work concerning injurious insects, the United States has been a leader among nations. Other countries have appealed to this one for assistance and advice, as well as for men to carry on similar work.

USEFUL BIRDS.

Systematic observations have been made to identify the injurious and useful birds and wild animals. In a general way it is true that most of the birds are more beneficial to agriculture than otherwise. An increasing understanding of this fact has undoubtedly checked the ruthless destruction of nongame birds and is now promoting their preservation. Some of these birds are of very large economic value to the farmer. The services of the native sparrows in destroying weed seeds have been valued at many millions of dollars annually. Were it not for woodpeckers and other insect-eating birds there would be forest destruction. Caterpillars which destroy the foliage of fruit and shade trees are the food of birds. The scale insects that infest fruit trees are eaten by no fewer than 57 species of birds. The execution of the Lacey law for the protection of game is under the administration of this Department and the interstate transportation of game in violation of law has practically ceased.

VARIOUS DISCOVERIES AND IMPROVEMENTS.

Millions of dollars have been saved to the handlers of tobacco leaf by the Department's discovery of a fermenting process for curing cigar tobacco.

A simple, cheap, and effective method of destroying the harmful bacteria and the algæ in water has been discovered and its usefulness widely demonstrated.

The important discovery was made that the loco disease of range stock was due to a metallic poison absorbed by certain leguminous plants eaten by stock on the range, and this discovery has indicated methods of control.

Laws have been enacted to protect the farmer against fraud in the purchase of fertilizers, foods, feeding stuffs, seeds, disease and insect infested plants.

Increased and wider knowledge of the nutritive value of food and of the better utilization of agricultural products as human food has followed the nutrition investigations of this Department, in cooperation with the experiment stations and other State institutions. Animal nutrition investigations, begun in cooperation with the Pennsylvania experiment station, are accumulating most accurate and scientific information, developed by use of the respiration calorimeter, an instrument invented by experts of this Department.

The Babcock test, invented at the Wisconsin experiment station, a simple method for determining the percentage of butter fat in milk, has entered more widely into use on the farm during the period under review, and a curd test has been invented for ascertaining the percentage of casein in milk, a matter of great importance to cheese factories.

Experiment stations have been established in Alaska, Hawaii, Porto Rico, and Guam, under the supervision of the Department. There is wider and more intelligent use of fertilizers, both farm-made and commercial.

Experiments conducted by scientific men in the feeding of farm animals to determine the relationship between feeds of different kinds and quantities on one hand, and gain in live weight in growing and mature animals on the other, have resulted in highly important discoveries which enable the farmer to feed with economy and to produce maximum results. One result of this new information is the marketing of meat animals at earlier ages than formerly, for which they are prepared by a forcing of growth. When approaching maturity of growth, the animal gains in weight at a greater and greater cost per pound of gain, and the fattening of a mature animal is a relatively expensive proceeding. Farmers have availed themselves of this knowledge generally throughout the principal live-stock States.

MARKETING PLANT PRODUCTS.

Marked improvements in methods of preparing, shipping, storing, and otherwise caring for the products of the soil have resulted from the practical field experiments of the Department and the stations. This work covers the storage of commercial seeds; the handling, transportation, and standardization of grain; and the handling and baling of cotton.

Perhaps the widest popular interest has been in the work of improved methods of caring for perishable products, chiefly fruits.

The Department has examined the practices followed in the California citrus groves, in the warehouses, and in other features of the citrus industry of that State. In consequence of this, the Department has induced the growers and warehousemen to adopt improvements which are probably saving to their industry more than a quarter of a million dollars annually. These improvements include the picking of the fruit, methods of packing, loading on cars, pre-cooling, and, indeed, the whole process from tree to market. The conditions of transcontinental shipment have been improved and attention is now given to trans-Atlantic exportation. This work has been extended to the Florida citrus industry and the deciduous fruit industries of New York, Iowa, and other States.

Markets for perishable fruits, such as peaches and pears, have been opened in foreign countries, and, through improved methods of storing and handling, these fruits have been kept free from decay when shipped long distances. Improved methods of harvesting, storing, and handling apples have led to remarkable changes in the selling of the crop.

Great advance has been made in improving the methods of exporting and grading grain. An apparatus has been developed and introduced for quickly determining the moisture content of grain which has placed this feature of the inspection work on a satisfactory basis.

ANIMAL INDUSTRY.

The dairy cow maintains an industry whose products are worth more than the wheat crop or the hay crop or "King Cotton." They go to almost every one of the 19,000,000 families of the country as milk or butter or cheese, but more especially as milk. It is a matter of greater concern to the public than ever before that milk and butter should be wholesome and unadulterated. The quality and healthfulness of these products largely depend on bacteria. It has been necessary to educate the dairyman and the public in the exclusion of injurious bacteria and in the use of beneficial bacteria of such kinds as impart the desired flavors to butter and cheese. Such education has been immensely promoted by the work of the Department and of the experiment stations during the period under review.

IMPROVEMENTS OF THE DAIRY INDUSTRY.

This Department has organized and perfected a system of inspection of dairies and milk-distributing plants which within two years has been adopted by over 140 of the larger cities. It has great value in giving to dairies a definite rating on the basis of a score card in which 100 points are perfect, and the application of this inspection is distinctly educational. Definite things are pointed out where improvement can be made, and the system has been received with great favor by the authorities in charge of dairy inspection.

Under a special appropriation by Congress a systematic effort, in cooperation with State authorities, has been made to introduce dairying into the South where it has not existed before. It has been demonstrated beyond doubt that dairying can be carried on profitably in the South, and not only have southern farmers been enthusiastically engaged in the work, but some of the States have made appropriations for its extension.

Supplementary to the inspection of creameries performed by State dairy officers, this Department has initiated a system of market inspection of butter followed by reports back to the creameries in which it is made, the object being to provide the butter maker with information concerning defects. Through the efforts of the Department there has been a general awakening on the part of creamery owners and managers to the immense loss annually sustained by reason of incompetent business management, and the publicity given to this work has caused three great dairy schools to offer this winter for the first time special courses in creamery management.

The educational work of the past twelve years in behalf of improved dairy conditions has caused, through private means, the organization of a national dairy show association, which holds an annual show in Chicago. It brings together everything in dairying from the breeding and feeding of dairy stock to the finished dairy products in the form of butter, cheese, and milk. It is the center of a great annual gathering of dairymen in the broadest sense of that term and is becoming a great factor in dairy education and advancement.

Experiments by this Department within a few years have practically demonstrated that butter manufactured from sweet pasteurized cream without fermentation of any kind has keeping qualities greatly superior to butter made from ripened cream, as in the prevalent practice. The introduction of this system will mean the saving of cost in manufacture. Distinct progress has been made in determining the causes of the undesirable flavors in butter and in suggesting means for preventing their development.

The percentage of moisture in butter has become of some importance for the reason that it is possible to load butter with water without detection by the consumer. Various devices have been contrived for determining the percentage of moisture, and some of these enable butter makers to prevent the percentage of water from exceeding the limit prescribed by law.

Butter making in the home dairy and creamery has been almost revolutionized by the introduction of the farm separator, which separates cream from milk by a centrifugal process. The shallow pan or crock system and the deep-setting system have been largely eliminated, and with their exit a considerable part of the drudgery of the household disappeared. The farmer is now no longer required to make the daily trip to the creamery; he can retain the skim milk to feed his calves and pigs and deliver the cream, sweet, every other day, when properly cared for, and this substitution of cream delivery for milk delivery by creamery patrons saves them labor and millions of dollars yearly in expense.

Dairy education at our agricultural colleges has proved most effective. Short "trade dairy school" courses have been provided for those already experienced in the work of cooperative and proprietary creameries and cheese factories. By such means American butter and cheese have been revolutionized in quality and uniformity and greatly increased in quantity and at the same time in the prices they command. Home dairying, as taught in agricultural schools, is also having a marked influence on the amount and quality of dairy products produced and on the profits from dairy farming.

MEAT INSPECTION.

Meat inspection under the National law has extended from a few of the larger packing establishments doing an export business in the largest cities twelve years ago to all the establishments of the country conducting an interstate or export trade in meat and food products. The scope of the work has been enlarged to include the supervision of the handling and the preparation of all meat food products and the sanitary conditions under which they are produced, as well as the thorough inspection of the animals for disease before slaughter and at the time of slaughter. Inspection is now maintained at about 800 official establishments; market inspection is maintained in 35 cities; certificates of exemption from market inspection are held by 1,992 retail butchers and retail dealers. During the year ending June 30, 1908, 54,059,901 cattle, sheep, swine, and goats had ante-mortem inspection; 53,973,337 of the same sort of animals had post-mortem inspection, and the meat and food products inspected weighed 5,958,298,364 pounds.

DISEASES AND THEIR REMEDIES.

Important discoveries worth many millions of dollars to the farmers of the country have been made concerning the causes of and cures for animal diseases. The cause of hog cholera having been discovered, a cholera serum was prepared, and its use has demonstrated that it is a practical, trustworthy, and cheap preventive of this disease.

Methods of quarantine control of hog cholera have been worked out in some States and, with a preventive in the form of a serum, there is rising the hope that this disease, which causes millions of dollars of loss annually, may be eradicated.

After several years of experiments it was discovered by the Department that human tubercle bacilli were capable of producing tuberculosis in cattle, and that tubercle bacilli isolated from cases of tuberculosis in children possessed all the characteristics of tubercle bacilli of bovine origin, thus pointing strongly to the danger of human infection from bovine sources.

Great progress has been made in devising methods of freeing herds of cattle from tuberculosis. Some States have induced all breeders of pure-bred cattle so to handle their herds as to be able to sell only tuberculosis-free breeding animals.

In 1896, 35,000 doses of tuberculin and 1,200 doses of mallein were distributed free of charge to officers of health throughout the country for testing dairy cattle for tuberculosis and horses for glanders. In the year ending June 30, 1908, 213,000 doses of tuberculin and 52,000 doses of mallein were distributed. Thus it appears that the efforts of the Department to assist health officers and farmers in the reduction of bovine tuberculosis are bearing fruit. Since 1901 all imported cattle have been subjected to the tuberculin test.

In 1896 a satisfactory vaccine for the prevention of blackleg in cattle having been discovered, its manufacture and free distribution to the cattle raisers of the United States were begun. The use of this vaccine has constantly increased, and during the past fiscal year 1,154,100 doses were prepared and sent out.

Owing to the rapid extension of sheep scab over the ranges of the West, it was deemed advisable in 1900 to begin active measures for its restriction and eradication. This work has been continued subsequently and now several States have been entirely freed from this disease. In 1903 similar work was undertaken against scabies in cattle and considerable headway has been made toward the eradication of that disease.

A method was perfected in 1903 for the rapid diagnosis of rabies, which consists of microscopic examination of the central nervous system where the presence of minute animal cells, known as Negri bodies, indicates the disease.

The losses from milk fever in dairy cows formerly reached a high figure, since only the more valuable cows in the herd are affected. In 1904 it became known that the injection of sterilized atmospheric air into the udder of the affected animal almost invariably resulted in a cure, and this method of treatment has been widely adopted through the efforts of this Department.

Texas fever has long been a cause of serious losses to the cattle industry of the South. After the discovery that many sections of that region were but lightly infested with the cattle tick which causes Texas fever, a movement was started in 1906 for freeing such sections of this insect, with complete success within an area of 64,000 square miles.

A strict quarantine system protects our live stock against the dangerous infectious diseases which prevail in other parts of the world, so far as they are liable to be introduced by imported live animals; and when on rare occasions some malady, such as foot-and-mouth disease, gains entrance into the United States in some other way, it is promptly eradicated.

The foregoing are some of the principal achievements to preserve and make profitable the domestic animals of the farm, which are worth $4,500,000,000; these achievements and the breeding work previously mentioned, as far as they relate to meat animals, have been devoted to sustain a capital of $10,500,000,000 invested in meat animals and live-stock farms and ranges.

CROP REPORTING.

From the moment when the planting and sowing of the seed have begun, popular interest in the prospective quantity of the crop production continues until the harvest; and the interest in cotton, wheat, corn, and some other crops is world-wide. To provide information concerning the condition of growing crops, the amount of the harvest, the number of farm animals, and other statistical details at the earliest date and in such a way that it may be given to everybody at practically the same time, and not be available to even one person in advance, the Department's crop-reporting system has been recognized and safeguarded beyond peradventure of premature use of its reports.

Statements upon which these are mostly based are kept under seal and lock and key until they are considered, and the persons who handle them on the days when reports are issued are in confinement until these reports have gone by telegraph to every part of the country. Instead of being prepared by one person, as formerly, the reports are constructed by a corps of five persons, no one of whom can foresee what they will be in any particular.

The crop-reporting work has been much improved in other respects, one of the most important of which is the establishment and development of a service of traveling field agents, with three branches. One is a general service in which each man devotes all his time to travel and inquiry; another is a partial service of personal inspection performed by a man in each State, who also has a corps of correspondents, and a third is a special service for selected crops in which the field agents travel and devote their attention to their specialties.

So great have been the improvements of the crop-reporting service and so well is it protected against abuse that it never before stood so high in public estimation as it now does.

AGRICULTURAL CHEMISTRY.

At the beginning of the period under review the work of the Department in agricultural chemistry was confined to an analysis of soils, fertilizers, dairy products and cereals, and to sugar-beet investigations; at the close of the period there is not an industry nor an activity bearing upon the welfare of the farmer that is not studied chemically, whether he be considered as producer or consumer.

Only a few of the particulars can be mentioned and these briefly. The manufacture of sirup from cane sugar has been studied, including the fertilization of the plant, improved methods of manufacture, and the chemical control of the factory operations with a view to producing a profitable merchantable product. In connection with this the suppression of sophisticated products and the proper labeling of substitutes are seen to be of very great agricultural importance in fostering the production of legitimate sirup.

Environment studies based on the chemical examination of products grown in different parts of the United States under close supervision have afforded valuable information as to the effect of variations in temperature and rainfall on the sugar content of beets and Indian corn and the protein content of wheat.

A chemical study of the composition and effects of insecticides and fungicides, the establishment of the futility or even harmfulness of some of them, and of the loss to the farmer resulting from false claims made on the labels of such products, have led to a movement for National legislation on this subject, many of the States having already enacted laws governing the sale of such products.

The problems of soil analysis and fertilization have been attacked along the most painstaking and conservative lines, involving extensive pot experiments and the comparison of various methods of soil and plant analysis to determine the specific fertilizing needs of a given soil for a stated crop. The simple consideration of the determination of potash, nitrogen, and phosphoric acid in the soil has given way to the most complex studies of all soil constituents, both organized and unorganized.

Microchemistry and bacteriological chemistry have come to the aid of the soil and the food chemist especially and play a conspicuous part in solving the problems and meeting the emergencies which confront the practical chemist of to-day. Physiological chemistry has become an essential factor in the work, especially in the determination of injuriousness of preservatives or coloring matters added to foods and the specific action of certain drug products.

DENATURED ALCOHOL.

An important piece of legislation, in which chemistry has played and must continue to play a conspicuous part, is the denatured-alcohol act, for only by opening up possibilities for the utilization of agricultural wastes in its production and ultimately furnishing to the farmer a convenient source of light, heat, and motive power, and to the trade a cheaper industrial alcohol, can the object of the law be fully attained.

BENEFITS OF CHEMISTRY TO THE FARMER.

The economic trend of much of the work in agricultural chemistry is further illustrated by the studies made to prevent the injury to forests, crops, and stock by wastes from smelters and factories, while at the same time the manufacturer may learn from the chemist, in many cases, to convert a waste, previously a menace, into an additional source of profit.

While the chemistry of the sugar beet twelve years ago was largely concerned with the problems of its introduction, the chemistry of to-day has to consider the improvement and extension of a successful industry, in the production of a beet of high sugar content, in solving the problems which arise in manufacturing the sugar therefrom, and in converting the wastes into merchantable products, the latter being successfully effected in several ways. Here, as in the canning industries, the production of tannins, the making of paper, and the production of turpentines, the part played by chemical research in improving processes, introducing new materials, and conserving resources reacts to the benefit of the farmer, not only in increasing the market for his produce, but by enabling him to improve the character of his crop and insuring the return to him of a better manufactured product. An investigation apparently so far removed from immediate interest to the farmer as the extensive paint and varnish investigations now making is found to concern him in the production of flaxseed for the manufacture of linseed oil.

The great agricultural interests of the country have had no more efficient and unflagging servants than the official chemists, both in Federal and State employ, who have labored in their behalf. As an index to the growth of this service it may be noted that the Association of Official Agricultural Chemists, which in 1897 mustered some 58 members with 9 referees, considering soil and fertilizer analysis, dairy products, fermented beverages, sugar, tannin, and feeding stuffs, in 1908 had 200 chemists assembled in convention who were concerned in the official control of foods and fertilizers, whose standards and methods are quoted in the courts, in administering the laws, and whose referees and associate referees, conducting work on every phase of food and agricultural chemistry, numbered about 50—nearly as many as the entire attendance at the meeting held twelve years ago.

PURE FOOD AND DRUGS.

Throughout this period the researches of chemistry into the composition of foods and their sophistication, and the publication of these results, have been slowly creating the public opinion which resulted in the passage of the food and drugs act of June 30, 1906. Back of this result lies a mass of laborious detailed work and scientific research necessary to differentiate between pure and impure products, to establish standards, to prove to the manufacturer the practicability of maintaining such standards, and insure their maintenance in the courts. Should this seem a far cry from the progress of agricultural chemistry, it must be remembered that the repression of sophistication means the increased demand for the best and purest products, besides the protection of the public health.

The report of the Chemist for 1897 contained plans for work on infants' and invalids' foods and the study of cereals and milling products; the report for 1908 contains the account of the first year's work under the pure food and drugs act, with a fully organized corps of 40 inspectors at work in the field, 21 inspection laboratories scattered through the country, and behind these, as they were behind the first movement toward the law, scores of specially trained chemists and bacteriologists, performing not only the mass of routine chemical work necessary to inspection, but conducting researches into every phase of food and drug chemistry necessary to the just enforcement of the law. The public health ranks very high in the welfare of the Nation, and without the progress which has been made in agricultural chemistry, though it be detailed and not capable of description under specific discoveries, the need of the food law would hardly have been discovered and the public opinion necessary for its passage could not have been aroused, nor could its provisions have been executed after its passage.

That foods should be wholesome and what they are represented to be is insured by chemical inspection and examination; that drug products of known quality should be available for the use of the physician, and that injurious or, at best, worthless preparations should not be foisted upon the people without their knowledge, are among the services rendered to the community by agricultural chemistry in the broad sense in which the enlightened policy of the past decade has interpreted it.

ROAD IMPROVEMENT.

The United States has now entered upon a great era of road improvement. The State aid and State supervision plan, beginning with New Jersey in 1891, has been adopted in principle by about twenty States, resulting in large appropriations from State funds, skilled supervision by competent highway engineers, and in many cases the utilization of State prisoners for road work. In many States individual counties are accomplishing by large bond issues and practical management results as satisfactory as are accomplished by State aid.

The demand for men specially qualified in highway engineering is increasing at a rapid rate, and for this reason the Department has cooperated with educational institutions and urged the establishment of courses in highway engineering, or a modification of civil engineering courses, so as to provide the necessary instruction. Many colleges and universities are making definite progress along these lines. In connection with this movement, the Department has for several years appointed annually a small number of graduates in civil engineering and given to them thorough and practical training in highway work for one year. A number of these young engineers have passed from the Department's service to important situations in State and county road work.

MATERIALS AND CONSTRUCTION.

In many parts of the country almost devoid of road-building rocks, the cost of macadam roads is prohibitive. Experiments have demonstrated that the sand-clay method of road construction is a fairly good substitute for macadam road, and roads so built are giving satisfaction in various Southern States.

Burnt clay is another material with which experiments have been made in road construction, and it is found to be desirable to use this material where macadam roads can not be made, at a cost of not more than one-third of the usual cost of the latter.

Dust prevention on public roads has received investigation in this country as well as in European countries. The materials used in the experiments of the Department have included, among others, tar preparations, asphalt, oils, such temporary expedients as calcium chloride, and several special preparations originating in the Department. The testing of road materials to determine their suitability for road building has reached a high state of efficiency in this Department.

Object-lesson and experimental roads have been constructed by the Department in many States, the construction of each road being made the occasion of instruction to persons concerned in the building and care of roads.

About 20,000,000 tons of blast-furnace slag is produced yearly in this country, most of which is a total waste. The Department has shown that this material, when combined with tar and asphalt preparations, is excellent for road construction. Experiments also indicate that a by-product of beet and cane sugar factories, now having little commercial value, is suitable for binding road materials.

The demands upon the Department for expert advice on road construction and maintenance have grown continuously in recent years both in volume and complexity, so that a corps of consulting highway engineers of the widest possible experience and adaptability has grown up, supplemented by specialists in various methods of construction and lines of experimentation.

PROGRESS IN SOME STATES.

Some States are rapidly giving more permanent construction to the principal highways. The State of New York in a recent year expended for this purpose more than $1,000,000; Massachusetts, about $575,000; Connecticut, about $220,000; New Jersey, about $250,000; Pennsylvania and Vermont, about $130,000 each. Among the States that have pushed this work the more rapidly are Massachusetts and Rhode Island, where about one-half of the mileage of the public roads is improved; Indiana and Ohio, with more than one-third improved; California, with about one-fifth; Connecticut, Kentucky, New Jersey, and Wisconsin, with more than one-sixth; and Illinois, Maine, Maryland, Michigan, New Hampshire, New York, Tennessee, and Utah with about one-tenth.

WEATHER SERVICE.

The field of daily telegraphic meteorological observations for forecast purposes, which in 1896 was limited to the United States and Canada, has been extended by the Department to embrace at the present time the whole northern hemisphere. Forecasts which formerly were limited to a period of twenty-four to forty-eight hours in advance are now frequently made from four days to a week in advance. In 1896 forecasts were telegraphed daily at Government expense to 1,896 distributing stations, from which points they were distributed by mail, telephone, railway train service, and railway telegraph service to 51,694 addresses without expense. On June 30, 1908, the daily forecasts were being telegraphed at Government expense to 2,334 distributing centers, from which points they were distributed gratuitously to 76,154 addresses by mail, 58,008 by rural delivery, 2,139 by railway telegraph, 852 by railway train, and 3,553,067 by telephone, making a grand total of 3,690,220 addresses, of record, receiving the daily weather forecasts without expense, except for the initial cost of telegraphing the information from the forecast district centers. The storm-warning display stations have been increased from 253 to 321. There has been an addition of 78 stations where daily meteorological observations are taken and telegraphed.

FEATURES OF THE WORK.

The output of daily weather maps has been increased about 25 per cent, and a number of large glass maps for the display of weather information have been installed at the boards of trade and chambers of commerce of the principal large cities of the country.

The number of cooperative stations where observations of temperature and rainfall are made for use in establishing the climatology of the country has increased by 621.

The field covered by the river and flood service, which in 1896 embraced only the principal navigable rivers, has been extended so as to cover every river of importance in the entire country, except where the lack of necessary facilities has prevented efficient communication; and the number of district centers has been increased by 30, the river-gauge stations by 231, and the rainfall observing stations by 69.

A research observatory was established at Mount Weather, Virginia, in 1903, for studying the upper air and investigating the higher problems of meteorology. Problems of water evaporation have been investigated at the Salton Sea and at principal reservoirs of the Reclamation Service. The ocean meteorological service, which has been transferred from the Navy Department to this Department, now includes reports from over 2,000 cooperative observers, and from these reports are prepared data for publication on the Pilot Chart issued by the Hydrographic Office. Buildings for use as meteorological observatories and living quarters for observers at stations have been erected or purchased at 37 places. Valuable works on climatology and meteorology have been prepared and published, including the climatology of the United States, a revised method for the reduction of barometric observations, and the preparation of new temperature and rainfall normals.

Great improvement has been made in the equipment of instruments used in the weather-forecasting service. A standard station meteorograph for the automatic and continuous registration of wind direction and velocity, sunshine, and rainfall has been developed and perfected, and every regular telegraphic reporting station is now equipped with it as well as with other automatic recording instruments, so that all local atmospheric conditions are now registered with great accuracy. A special meteorograph for use in upper-air exploration has been devised and brought to a high state of efficiency and is now used at the research observatory at Mount Weather.

To meet the demands for local meteorological data a form of street instrument shelter, or kiosk, has been devised, of neat ornamental design, for use in the parks or on sidewalks in busy parts of the larger cities. Within this shelter are displayed, behind protecting glass fronts, instruments giving continuous records of temperature, humidity, rainfall, etc., together with an appropriate display of daily weather maps, climatic charts, and other publications of special local interest.

The allotment of money for telegraphing and telephoning weather reports has been increased by 25 per cent during the period under review. New submarine cables have been laid from Key West to Sand Key, Florida; from Sleeping Bear Point to South Manitou and North Manitou Islands, Michigan; from Charlevoix to Beaver Island, Michigan; and from Point Reyes to the Farallon Islands, California—these isolated stations being maintained for the benefit of extensive shipping interests.

FOREST SERVICE.

For Americans ten years ago forestry had neither a practical basis nor practical interest. On July 1, 1898, there were two professional foresters in the employ of the Government, less than ten in the whole country, no school of forestry on the Western Hemisphere, no scientific knowledge of the first principles of American practice in existence. The very word forestry was usually meaningless except as it was misunderstood.

FOUNDATIONS OF PRESENT POLICY.

The foundations of the present National Forest policy had, it is true, been laid. Yet so feebly were these foundations supported by popular approval and so dubious was the prospect for rearing a proper superstructure upon them that there was no security for their permanence. President Cleveland had by his proclamation of February 22, 1897, turned at a single stroke over 21,000,000 acres of public land into National Forests, but because of the belief that this action meant their withdrawal from use a storm of protest had led to the suspension of the effect of the proclamation for a twelvemonth, during which the whole reserve policy hung in the balance. The law of June 4, 1897, which accomplished this suspension, also laid down the lines along which the Government's forest policy has ever since developed by defining the purpose for which forest reserves could be created and authorizing their protection and administration; but not until more than half a decade afterwards was there an application of anything actually approaching forestry.

A complete change has been wrought in the attitude of the public toward the forests primarily and mainly by a knowledge of the facts shown by this Department. The change in public sentiment and the growth of forest service have been most rapid. The Department employed but 14 persons in 1897 in this work. Not an acre of land, public or private, at that time was under its care or receiving the benefit of its advice. There was no equipment for field work and frequently no information available upon which to base practical advice concerning forest management. The National Forests, with a total area of 39,000,000 acres, were about to receive for the first time some organized administration and protection through the General Land Office.

MAGNITUDE OF THE FOREST WORK.

At the beginning of the fiscal year 1909 the Department employed 3,753 persons in its Forest Service. Its expenditures for the year 1908 were over $3,400,000. It administered an area of National Forests which before the end of the year aggregated almost 168,000,000 acres, and which paid into the Treasury of the United States over $1,800,000 in receipts. It supervised the cutting and removal of the equivalent of over 524,000,000 board feet of timber under methods which provide not only for the renewal of the forest growth but also for the improvement of its character. It prosecuted studies to further the best use of forests and forest products throughout the United States. It proved its capacity to manage the actual practice of forestry on the entire area of National Forests, embracing about one-fourth the timbered area of the country, whenever the public need brings full use of all the forests. It is equally prepared to take the lead in introducing forestry wherever in the United States its practice is desired. It has solved the problem of preservation through use, and thereby holds in its hands for the service of the public the means by which one of the most fundamental of our natural resources may be maintained in full and permanent productiveness.

RECLAMATION ACT.

New lines of work are coming to this Department and to State officials charged with looking after agricultural interests in consequence of the law of June 17, 1902, known as the Reclamation Act. When this began to provide income from the sale of public lands for the reclamation of arid lands by means of irrigating works, a movement of great magnitude began under the Department of the Interior, the results of which are already beginning to appear. The receipts of money for this purpose, beginning with the fiscal year 1901, had amounted to $33,302,855 by June 30, 1906; the estimated receipts during the following four years ending with 1910 are $24,800,000; so that by the end of the year last mentioned $58,000,000 will have been received and mostly expended to promote agriculture on desert land.

In the prosecution of this reclamation service, many projects have been planned, the irrigated area of which, as now appears, will be about 2,300,000 acres, at a cost of about $90,000,000.

Some of these projects for reclaiming land by irrigation have bold features which give evidence of the large scale on which the Government is working to make the desert fruitful and to provide homes for hundreds of thousands of farming people—perhaps millions eventually.

SEVERAL PROJECTS.

The Salt River project in Arizona will irrigate 210,000 acres, and there must be made a tunnel nearly 2 miles long and a dam 1,080 feet long and 284 feet high, which will provide about 8,000 horsepower.

In the execution of the great Uncompahgre project in Colorado, which will irrigate 146,000 acres, it is necessary to excavate the Gunnison tunnel, about 5½ miles long, and another tunnel 2,000 feet long, besides excavating main canals for 77 miles and providing 5,000 to 10,000 horsepower.

The Minidoka project in Idaho, in its gravity project, will irrigate 84,200 acres, will have 130 miles of main canals and 190 miles of laterals, and provide 15,000 to 30,000 horsepower.

An irrigated area of 372,000 acres will be provided by the Payette-Boise project in Idaho, which will supply a power of 12,500 horsepower and utilize 200 miles of main canals and 100 miles of laterals.

A dam 6,200 feet long is part of the Belle Fourche project in South Dakota for irrigating 100,000 acres; the length of the main canals will be 100 miles, of the laterals 125 miles, and of the sublaterals 1,000 miles.

PRESENT AND FUTURE OF IRRIGATION AND DRY FARMING.

In 1896 the irrigated acres in this country numbered about 8,000,000; in 1908 the number is about 13,000,000, and, when projects now in the course of execution by the Reclamation Service and by private individuals under the Carey Act are executed, the total irrigable area will be 18,000,000 acres.

It therefore appears that during the period under review steps have been taken and much progress made toward placing under cultivation immense areas of desert land by means of irrigation and of so-called "dry land" by means of suitable cultural systems. The foundation has already been prepared for the advent of millions of people on previously unproductive land to pursue agriculture in many of its features under conditions which promise prosperity and an enormous addition to the Nation's permanent wealth and to its annual production. In these two lines of agricultural development, in which this Department has already been concerned in the agricultural phases, there is much work for it in the future.

AGRICULTURAL EDUCATION.

STATISTICS OF INSTITUTIONS.

The total income of the agricultural colleges was $5,000,000 in 1897, $15,000,000 in 1908; the value of their property was $51,000,000 in the former year and $96,000,000 in 1907. The students in 1897 numbered 4,000; in 1908, 10,000.

One agricultural high school existed in 1897, and there are now 55. Not one normal school taught agriculture in 1897, but now 115 do so, besides many privately endowed schools. About half of the agricultural colleges now give training courses for teachers in agriculture; 44 States and Territories give some instruction in elementary principles of agriculture in the lower schools. The Graduate School of Agriculture for instruction of investigators and for discussion of advanced problems of research in agriculture was organized in 1902 and is now doing work under the American Association of Agricultural Colleges and Experiment Stations. A strong movement for the systematic organization of all agencies in agricultural extension work has been started within a few years, and the National Educational Association has added a department of rural and agricultural education.

Outside of schools which are for the education of youth and teachers in agriculture, the farmers have received a greatly increased degree of education by means of demonstration work and advice given orally and by letter, by countless official and private publications, by corn and live-stock judging contests, and by farmers' institutes. The number of sessions of the last named held in 1908 was 14,000, with an attendance of about 2,000,000 persons, an enormous increase over the attendance twelve years ago. About 1,200 trained lecturers are now employed in farm-institute work in all States and Territories.

NUMBER OF PUBLICATIONS OF THE DEPARTMENT.

The volumes and pamphlets issued by the States and Nation now number many millions annually, and supplementary to this is the circulation of the periodical agricultural papers, amounting to many millions more.

In 1897 the number of publications issued by this Department was 424, of which 6,541,200 copies were distributed; in 1908 the 1,522 publications of the Department were distributed to the number of 16,875,516. During the eleven years following 1897 this Department has printed 10,449 publications, including reprints, the distribution of which amounted to 129,129,633 copies. If the probable numbers of this year are added, the publications of the twelve years will be about 12,000 and the distribution about 146,000,000.

The Department Library has grown from 56,000 books and pamphlets in 1897 to about 101,500 in 1908. Exclusive of annual reports of societies and institutions, 1,850 periodical publications are regularly received. The increasing use of this great storehouse of agricultural information is having educational effects that penetrate to every part of the United States.

GROWTH OF THE DEPARTMENT OF AGRICULTURE.

So increasingly disposed has the public been to ask and receive the aid of this Department, and so large have been the new fields of work assigned to it by Congress, that the number of employees has increased enormously. On July 1, 1897, 2,444 persons were employed, and eleven years later, in 1908, the number was 10,420, or over four times as many. Upon localizing this increase, it appears that the number of employees of the Weather Bureau increased from 1,075 to 1,705; of the Bureau of Animal Industry from 777 to 3,152; of the Bureau of Plant Industry from 127 to 976; Forest Service from 14 to 3,753; Bureau of Chemistry from 20 to 425; and small increases in other Bureaus and Offices. It is significant to note that the increase in number of employees is mostly due to service outside of Washington, in all parts of the country. The number of persons employed within Washington is 2,488, and elsewhere 7,932.

In 1896 the Department of Agriculture was made up of two Bureaus and a number of Divisions. Seven other Bureaus have since been organized and the work of the Secretary's Office has been developed into Divisions. The general change to bureau organization has greatly facilitated the work, which has rapidly grown in volume and in efficiency. There has been developed a remarkable force of scientists, administrators, and helpers. The number of seasoned workers now ready to administer the research, the police functions, and the business of the Department is sufficient for any reasonable demand for new work.

A scheme of project statements has been devised which is centering in the Secretary's Office a plan for each line of work undertaken by the Department. This plan has now been so far tried by the Bureaus and also by a number of State experiment stations that its general use is assured. It promises to serve not only as a most valuable means of having plans for work thoroughly wrought out by leaders in charge of projects, aided by workers along similar lines and their superior officers, but also to be a most efficient agency to systematize permanently the organization of the activities of the Department.

The State agricultural colleges and experiment stations and departments likewise have developed corps of workers who are prepared to guide the great advances imminent in research, in education, and in scientific breeding. The relations existing among all these organizations were never so cordial as now, and far more effective cooperation is in vogue than ever before. The administrative officers and workers of the Bureaus of the Department and of the State institutions, having had experience in many forms of cooperation among themselves, have wrought out many of the principles governing these intricate cooperative relations.

RESULTS OF AGRICULTURAL SCIENCE ON PRODUCTION.

Tangible evidences of the beneficial results of the gigantic movement in agricultural instruction and improvement, of the unprecedented uplift of the farmer, and the betterment of country life, briefly outlined and indicated in the foregoing pages, are found in the wonderful increase in diversification and geographic extension of products, apart from any mere cultivation of new land, and are recorded with arithmetical precision by the increased production per acre of various crops for which facts are known.

It must be remembered that this country is passing through historical phases of agricultural production. First comes the exploitation of virgin land by the soil robber, a proceeding that is justified by the poverty of the settler or his lack of capital; next is the diminished production per acre, which surprises the farmer, and for which he is unable to account; next is the receipt of information from the scientist as to the means of improving the productivity of the land, with slow response; in the course of time, especially when the next or perhaps the third generation takes the farm, important advances are made, at first irregularly and mostly on the farms of the leading farmers, and subsequently with increasing diffusion and accelerated speed.

INCREASED PRODUCTION PER ACRE.

In the case of all crops for which production per acre is known, there was an increase during the last ten years and also, in a somewhat less degree, in the case of most of them, during the last twenty years. This is the general fact for the United States in spite of the damaging effect on the general average by reason of decreasing production per acre from land that has not yet entered upon the final historic stage of agriculture.

The farmers of this country have now made a creditable beginning in this last phase of historic agriculture. It is now a movement of masses as well as of leaders. It is more and more a diffused movement in place of being broken up into localized efforts. This movement has gained most of its headway during the last twelve years. Increased production per acre is clearly indicating the extent and force of this uplifting movement.

EVIDENCES OF A NEW AGRICULTURE.

During the ten years 1877–1886 the mean yield of cotton per acre in all States, new land and old being combined, was 170 pounds; during the ten years ending with 1896 the mean was 172 pounds; and the increase from that figure during the succeeding ten years ending with 1906 was to 191 pounds, or 11 per cent above the yield of the preceding ten years.

Most interesting now is the testimony of the older cotton States to the arts and sciences of agriculture. In North Carolina the mean production of cotton per acre increased from the ten years ending with 1896 to the ten years ending with 1906 by 21.8 per cent; in

South Carolina, 20.4 per cent; in Georgia, 15.9 per cent; in Mississippi, 16.9 per cent; and in Tennessee, 11.5 per cent.

Other crops join hands with cotton in swelling the evidence. Within ten years, mean figures being adopted as before explained, the production of corn per acre in Ohio increased 17.5 per cent, and in Virginia 18.3 per cent; oats increased 17.9 per cent in Indiana.

Wheat increased 16.2 per cent in New York, 45.9 per cent in Nebraska, 14.5 per cent in Maryland, 19.1 per cent in Virginia; barley increased 13.6 per cent in Wisconsin; rye, 24.4 per cent in Pennsylvania, 14.5 per cent in Michigan; buckwheat increased 14.7 per cent in Maine and 21.9 per cent in Pennsylvania; potatoes 39.1 per cent in Maine and 22.1 per cent in Wisconsin.

Increase for hay was 14.3 per cent in Kentucky, 27.7 per cent in Minnesota, 19.4 per cent in North Carolina, 19.5 per cent in Georgia, 17.6 per cent in Alabama, and 30.8 per cent in Oregon.

In some degree this upward movement began twenty years ago, for during that time corn production per acre increased 25 per cent in Illinois and 21.7 per cent in Virginia; the production of oats increased 32.4 per cent in Maine; wheat increased 30.6 per cent in Iowa, 37.3 per cent in Nebraska, 23.4 per cent in Maryland, and 27.7 per cent in Virginia; rye increased 39.3 per cent in Pennsylvania; buckwheat increased 40.3 per cent in Maine and 26.9 per cent in Pennsylvania; potatoes increased 54.5 per cent in Maine, and hay increased 23.2 per cent in North Carolina, 32.8 per cent in Alabama, and 35.1 per cent in Oregon.

DIMINISHING RATE OF INCREASE IN POPULATION.

The most important meaning of the percentages of increased production per acre is found in a comparison with increase of population. The United States is accompanying the peoples of western and southern Europe in a decreasing birth rate and in a diminishing increase of population. The population of Europe, excluding Russia and Turkey, increased 8 per cent during the ten years ending with 1880, slightly less than 8 per cent in the ten years ending with 1890, and slightly more than 8 per cent in the following ten years. These people belong to the race stocks of the United States.

In this country the increase of population is complicated with an influx of the foreign born and with a higher birth rate of the foreign born than that of the old native stock. These are having a temporary effect upon the actual rate of increase; after an elimination of these temporary elements, which serve only to mislead to extravagant computations of population at distant years in the future, the natural rate of increase of the population of this country, native born of native parents, appears to be approximately 12½ per cent during a decade, or 1¼ per cent yearly, with a tendency toward diminution in the rate. This conclusion has been elucidated by the Chief Clerk of the Bureau of the Census in recently published writings concerning this subject.

PRODUCTION AND POPULATION.

The percentages of increase of crop production per acre now have a new significance. No one need fear that the farmers of this country will ever be unable to provide for its population. They are already demonstrating in the cases of various crops and of various States that they can provide for a population increasing faster than by increase due to excess of births over deaths.

The wheat and rye production of 12 countries of Europe, representing substantially the entire production outside of Russia and Turkey, increased by 15.2 per cent from 1886–1890 to 1901–1905, and the population increased from 1888 to 1903 but 13 per cent.

WAGES OF FARM LABOR.

Extraordinary prosperity following the low financial condition of farmers a dozen years ago and earlier has enabled them to pay higher wages for farm labor than before, and this fact may indicate an improved condition of the farm laborer, at any rate to the extent that he is disposed to improve.

From 1895 to 1906 farm wages increased in a greater degree than prices did. The percentage of increase of prices of all commodities, according to recognized authority, was 35.8 per cent, while the wages of farm labor by the month for the year or season without board increased 38.4 per cent and with board 41.4 per cent; wages by the day in harvest without board increased 46.5 per cent and with board 55.4 per cent, and the wages of ordinary labor by the day without board increased 55.6 per cent and with board 61.3 per cent.

In the matter of wage increase the farm laborer has fared better than the workingman employed in manufacturing and mechanical industries.

STATISTICAL ASPECTS OF PROGRESS.

Precise ideas of the progress of agriculture, of the farmer, of his capital, of his production, and of his financial improvement may be obtained by a quantitative comparison between the average of the last five years ending with 1908 and the average of the five years ending with 1896 or thereabouts. The comparison will indicate by percentages of increase the advance that the farmer has made in twelve years.

INCREASE OF CROP PRODUCTION AND VALUE.

Cotton production increased 53.4 per cent and the total value of the crop 133.4 per cent; corn production increased 25.7 per cent, compared with the census of 1890, and the total value of the crop 110.5 per cent.

Wheat's increase is 39.8 per cent in bushels and 64.8 per cent in total value in comparison with the census of 1890. For rice the increase of production is 303.3 per cent; the barley increase is 98.2 per cent for bushels and 130.9 per cent for total value.

For potatoes the increase is 35.5 per cent in production and 118.9 per cent in total value; for tobacco 35.3 per cent for production and 98.3 per cent for total value. Since 1892–1896 beet sugar production has increased 1,404.6 per cent.

The value of all products of the farm this year is an increase of 216.2 per cent over the census value of 1889.

Horses increased 33.6 per cent in number since 1890 and 81.2 per cent in total value; mules increased 68.5 per cent in number and 132.1 per cent in total value. Sheep increased 90 per cent in number and 224.5 per cent in total value; swine increased 22.1 per cent in number and 56.4 per cent in total value. Cattle, other than milch cows, increased 48.4 per cent in number and 64.9 per cent in total value, and milch cows 28.4 per cent in number and 77.8 per cent in total value.

FARMING CAPITAL.

The number of farms in 1890 was 4,564,641; in 1900 they numbered 5,737,372; and the present number is estimated to be 6,100,000, an increase of 33.6 per cent over 1890.

The total number of acres in farms increased from 623,000,000 in 1890 to 839,000,000 in 1900, or 34.6 per cent. Improved acres increased 15.9 per cent.

The capital of the farmer in the forms of land, buildings, improvements, live stock, implements, and machinery is supposed to be now worth about $28,000,000,000, an increase of 75 or 80 per cent over 1890.

AGRICULTURAL EXPORTS.

The exports of agricultural products of domestic production have increased noticeably in value and in the case of many items greatly in quantity during the last dozen years. A comparison of the average for 1904–1908 with that for 1893–1897 discovers that the total agricultural exports increased 53.7 per cent in value, while the population increased 24.4 per cent from 1896 to 1908.

The increased value of the exports of packing-house products is 40.6 per cent. The exported lard gained 32.9 per cent in number of pounds and 52.6 per cent in value; oleo oil, 74.4 per cent in weight and 72.8 per cent in value; hams, 80 per cent in pounds and 90 per cent in value; salted and pickled pork, 121.8 per cent in quantity and 187.1 per cent in value.

The most prominent export, cotton, gained 40 per cent in pounds of export and 102.2 per cent in value; cotton-seed oil cake and oil-cake meal gained 115.5 per cent in quantity and 187.8 per cent in value, and cotton-seed oil about the same. Fresh apples gained 130.8 per cent in number of barrels and 224 per cent in value; all fruits gained in export value 237.8 per cent.

The farmers have given to this country most of its balance of trade in the exchange of goods with foreign countries from the beginning. To whatever extent the subject is complicated with shipments of gold and silver and with transfers of credit is immaterial to the present mention of the subject. The fact is that the farmers of this country, through the exportation of their surplus of products, have been the chief instrument of strengthening the National credit abroad, of paying the foreign holders of the National bonds of this country, and of establishing credit in foreign countries against which drafts could be made.

During the twelve years under review the agricultural balance of trade increased from a yearly average of $234,000,000 to $411,000,000, or 75.7 per cent.

BANK DEPOSITS.

As an indication of financial results, a comparison of individual deposits in all banks July 1, 1896, with those of 1908 presents striking gains in agricultural regions. While Massachusetts and New York were gaining, respectively, 61.9 and 12.2 per cent in deposits, and the North Atlantic States 112.1 per cent, the North Central States west of the Mississippi River gained 258.5 per cent; Iowa, 285.5 per cent; Kansas, 333.7 per cent; Mississippi, 404.2 per cent; Oregon, 725.6 per cent; North Carolina, 405.4 per cent; and Arkansas, 534.7 per cent.

While these were not all farmers' deposits, yet they were mostly derived from the sales of farm products by farmers and the handlers of farm products.

FARMERS' COOPERATION.

Farmers' economic cooperation in the United States has developed enormously during the period under review, and it is safe to say that at the present time more than half of the 6,100,000 farms are represented in economic cooperation; the fraction is much larger if it is based on the total number of medium and better sorts of farmers, to which the cooperators mostly belong.

PROMINENT OBJECTS.

The most prominent object of cooperation is insurance, in which about 2,000 associations have probably 2,000,000 members. This kind of insurance costs the farmers only a very few cents per hundred dollars of risk above the actual losses.

The cooperative creameries number more than 1,900 and the cheese factories about 260, the membership of the two classes being very large and representing an immense number of cows.

With the exception of insurance, the greatest success in the farmer's cooperative movement is in selling. Associations to regulate, promote, and manage the details of selling the products of cooperating farmers are found in all parts of the United States. There is cooperation for selling by fruit growers, vegetable growers, nut growers, berry growers, by live-stock men, by the producers of cotton and tobacco, wheat, sweet potatoes, flax, oats, eggs, poultry, and honey. Farmers cooperate to sell milk for city supply, to sell wool, cantaloupes, celery, cauliflower, citrus fruits, apples, and so on with a long list.

Cooperative buying is conducted by about 350 stores in this country, a majority of which are mostly owned by farmers. This is chiefly the result of a very recent movement. Another form of cooperation for buying is based on the discount plan, as carried on by the granges, farmers' clubs, and various other associations of farmers with cooperative buying as either a primary or secondary object. Things bought in this way are all sorts of store goods; potatoes, wheat, etc., for seed; coal and wood, and a great variety of farm and family supplies.

Warehousing is conducted by farmers on the cooperative plan with success, particularly for the storage of wheat and corn. A cooperative cotton-warehousing movement is of recent date.

Cooperative telephone service has permeated vast regions, and the cooperative feature has kept the cost at the lowest figure, both of equipment and of service.

Cooperative irrigation is carried on by many thousands of associations in the arid and semiarid regions.

EDUCATIONAL, SOCIAL, AND ECONOMIC ASSOCIATIONS.

The progress of farmers in forming and expanding associations of an educational and semi-economic character has made great advances during the period under review. These associations are National in their scope, or are confined to State lines or to sections within States, and are devoted to the interchange of ideas and experiences, the assembling of information for common benefit, the holding of competitive exhibitions of products, the devising of plans for the common good, and business of a like character, and are concerned with special subjects, such as horticulture, floriculture, dairying, plant breeding, live-stock breeding, poultry breeding, the scientific aspects of breeding, forestry, agricultural education, fraternal associations with incidental educational and economic features, seed breeding, agriculture, vegetable growing under glass, and the nursery business.

Important associations of the social sort, with incidental economic features, are farmers' clubs, many hundreds of which exist.

THE FARMER A GREAT ORGANIZER.

Altogether the number of farmers' cooperative economic associations must be fully 75,000, and may easily be many more, with a membership rising above 3,000,000, without counting duplicates.

Contrary to his reputation, the farmer is a great organizer, and he has achieved remarkable and enormous successes in many lines of economic cooperation in which the people of other occupations have either made no beginning at all or have nearly if not completely failed.

CONCLUSION.

The foregoing review of agriculture in the United States during the last dozen years and of the progress made by the farmer has necessarily been highly condensed, and from it has been omitted a vast amount of information which, being in the form of details, would detract from the review as it stands. Enough has been presented, however, to establish the fact that agriculture has made wonderful progress and permanent advancement, and that the farmer in results of information, intelligence, and industry has thriven mightily. The progress that has been made is in the direction leading to popular and National welfare, to the sustenance of any future population, as well as to a larger efficiency of the farmer in matters of wealth production and saving, and in establishing himself and his family in more pleasant ways of living.

Details of the work of the Department are contained in the accompanying reports of the various Bureaus, Divisions, and Offices, the publication of which in connection with this report is respectfully recommended.

Respectfully submitted.

JAMES WILSON,
Secretary.

WASHINGTON, D. C.,
November 27, 1908.

REPORTS OF CHIEFS.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, D. C., September 28, 1908.

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1908.

WILLIS L. MOORE,
Chief of Weather Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

RESEARCH AT MOUNT WEATHER.

As stated in my last report, the administration building was totally destroyed by fire October 23, 1907. The destruction of the living quarters made it imperative to shelter the employees in such places as could be temporarily adapted to living purposes. Accordingly portions of the farm cottage, hitherto occupied by the laborers, and of the power house, the barn, and the stable were utilized for sleeping, eating, and cooking purposes. With one exception these buildings were not suitable for living quarters, especially during the inclement weather that prevails at Mount Weather in the winter season. Notwithstanding this fact the work of the observatory was carried on without complaint and with no material curtailment. Under the circumstances, however, it was impossible to enlarge the scope of the work.

The activities of the year may be classified under the following heads:

DAILY METEOROLOGICAL OBSERVATIONS.

Regular twice-daily observations of pressure, temperature, humidity, wind, and weather were made. These observations were telegraphed to the central office in Washington for the use of the Forecast Division.

UPPER-AIR RESEARCH.

During the year that ended June 30, 1908, records of pressure and temperature were obtained daily, except Sunday, by means of kites and captive balloons. These records were computed for each day so as to show all peculiarities or changes in the temperature gradient or air currents, altitudes of clouds, depths of cloud and fog layers, and the highest points reached. The tabulated results, together with observations and conclusions deduced from them, have been published in the Bulletin of the Mount Weather Observatory. Two numbers of this publication have already appeared, the third is nearly through the press, and the manuscript of the fourth is about ready for the printer. Daily upper-air data are also telegraphed to Washington for the Forecast Division.

The records are for the most part obtained by means of kites. On occasional days, when the wind is insufficient for kite flying, captive balloons are used. The mean altitude obtained during the year with captive balloons was 2,357 meters (7,732 feet). With the installation of the new kite reel, designed to carry 15,240 meters (50,000 feet) of wire and to run at rates of speed varying from 0.45 meter to 4 meters per second (1 to 9 miles per hour), the observatory will be well equipped for kite flying. The balloon ascensions during periods of very light winds are of great importance, in that they make the upper-air records continuous. Their need will justify the equipment of the observatory with the means of making and repairing its own balloons, and with a gasometer suitable for storing the gas that has been used in an ascension. At present this gas is wasted, and the capacity of the gas plant is insufficient to permit the use of more than one balloon in an ascension, while two could often be used to great advantage.

The only records now obtained are those of temperature, pressure, and wind direction. Instruments have been ordered, however, which will record the relative humidity also, and plans are being made to secure a record of the wind velocities in the upper atmosphere and to make the kites and balloons a means of studying the electrical conditions obtaining at similar heights.

The observatory also cooperates with the International Commission of Aeronautics in its endeavor to secure on fixed days upper-air data for a number of stations in the Northern Hemisphere.

WORK OF MAGNETIC OBSERVATORY.

The work in terrestrial magnetism was interrupted and seriously set back by the burning of all its records in the fire that destroyed the main building. In beginning anew, advantage was taken of the opportunity to rearrange and improve the operation of the Wild magnetographs. In particular, the two horizontal intensity magnetographs of that type were oriented to register the east-west and north-south components of the horizontal intensity, as recommended by the international committee.

All of the magnetographs have now been provided with electromagnetic coils for determining their scale values at frequent intervals. These coils are of the type used on the magnetographs designed by Ad. Schmidt for the new magnetic observatory at Seddin.[a] The work of standardizing the magnetometer and the magnetographs has been taken up and the constants for the Wild magnetometer have been determined with sufficient accuracy for the current reduction of the absolute observations. More accurate determinations will result as the new apparatus just received is put into use and the number of observations increases. The temperature and distribution coefficients are being determined from the regular weekly observations, and a higher degree of accuracy will accrue from an increased number of observations.

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[a] Zeitschrift für Instrumentenkunde, May, 1907, p. 137.

The scale coefficients of the magnetographs have been accurately determined. Preparations are now being made to obtain the temperature coefficients of these instruments by subjecting them to artificial variations of temperature in an air bath, the temperature of which can be controlled automatically.

An account of the methods and the instruments used in these experiments and a summary of the results obtained are being prepared and will probably appear in the Bulletin of the Mount Weather Observatory.

The tabulation of the hourly values of the magnetic elements from the photographic records has been begun and will be carried forward to such a point that it will only require the application of the temperature correction to obtain the true values.

Action has been taken to secure from the magnetic observatories of the Coast Survey and from a number of foreign observatories data for the investigation of the time relation of the beginning of magnetic disturbances in the different places on the earth, from which it is hoped to obtain results that will throw light on the nature and mode of progression of those disturbances that are believed to proceed from the sun.

SOLAR PHYSICS.

The work in solar physics as conducted at the present time consists in the measurement of the amount and intensity of solar radiation, the degree of absorption of the earth's atmosphere, and the polarization of blue sky light, and in the determination, by means of these data and an empirical formula developed by Prof. H. H. Kimball, of the solar constant or the heat received at a point just outside of the earth's atmosphere. The instrumental equipment includes two Angström pyrheliometers and a Pickering polarimeter, together with a storage battery, a mil-ammeter, and a rheostat. Values of the solar radiation are obtained, which, with other data, including the vapor pressure, may make it possible to compute the solar constant and, finally, the amount of absorption by the earth's atmosphere. The work is facilitated by the use of reduction tables and especially by the employment of a diagram that shows the air masses through which the sun's rays pass at different hours of the day and for different declinations of the sun.

This work was begun at Mount Weather in September, 1907, and observations have been taken every day since, with the result that up to July 1, 1908, thirty determinations of the solar constant had been made. An extra pyrheliometer is used in making comparative readings to detect any changes that may be taking place in the constant of the station instrument. Readings with the Pickering polarimeter have been made on every day, but thus far these have not been reduced.

During the ensuing year it is planned to continue observations along the same lines as heretofore.

SOLAR RADIATION.

Atmospheric conditions of temperature, moisture, and sunshine may be said to control almost completely the growth of vegetation in general.

Observations of temperature and moisture have been made by meteorologists for many years, but measurements of solar radiation have been almost entirely restricted to laboratory investigations, and even then nothing has been attempted on a scale sufficiently comprehensive to show the radiation available during the entire day or during the growing season. Heretofore apparatus capable of giving in reliable form the data required have not been available, and instruments designed to meet the requirements can be used successfully only by observers of exceptional training.

An instrument that promises to give good results and which records continuously the total radiation received from the sky, as well as from the disk of the sun when not obscured, has been procured and will be tested by the Instrument Division to determine its reliability.

The records from this instrument will show day by day the total radiant energy upon each unit of area of the surface of the earth, and such data summarized for different regions should be of value when used in connection with studies of the growth and development of plant life.

SOLAR CONSTANT.

A phase of this problem of the measurement of solar radiation has been the subject of several years' study by Professor Kimball—namely, the determination of the total heat that reaches the outside limits of the earth's atmosphere. It is only within recent years that scientists have been able to demonstrate that the solar radiation is variable. One outcome of the studies conducted at the Weather Bureau has been to make plain the errors of the apparatus heretofore employed in these investigations. At the suggestion of Professor Marvin arrangements have been made to use a special type of electrical pyrheliometer, with which it is hoped to attain greater accuracy and to avoid the deterioration with age that is characteristic of the older apparatus.

STUDY OF APPARATUS.

In July, 1907, a series of comparative readings was obtained from the Angström pyrheliometer and the Smithsonian actinometer. In December following two additional instruments were received from Angström, the constants to one of which he had determined with care, and in accordance with his suggestion this instrument has been preserved as a standard. In February, 1908, a second series of comparative readings from Angström and Smithsonian instruments was obtained, and the fact established that the reduction factors for Angström pyrheliometers change slowly with age. Effort has been made to obtain an instrument not subject to these changes, and an order has been placed for a new pyrheliometer, the essential features of which have been suggested by Professor Marvin.

At present eye readings of the pyrheliometer are made at frequent intervals whenever the sky is free from clouds, and the data obtained are tabulated, so as to show the relative amounts of solar radiation received at different seasons of the year and in different years. It is not possible by this method to obtain continuous records of the quantity of solar radiation received under all sorts of atmospheric conditions. A Callindar recorder, designed for use in connection with a special form of pyrheliometer, is now being tested, and it is hoped that with it the desired continuity of records may be obtained. In its present form the instrument records the radiation received from the entire sky.

NEW FORMULA FOR COMPUTING THE SOLAR CONSTANT.

An equation has been developed by means of which the atmospheric transmissibility for solar energy of different wave lengths may be computed with reasonable accuracy from pyrheliometric observations, most conveniently from observations with the sun from 20° to 30° above the horizon, provided the water-vapor content of the atmosphere at the same time is also known. This formula has been applied to pyrheliometric observations obtained at Washington on 69 different occasions between December 22, 1905, and June 30, 1908, and to observations obtained at Mount Weather on 26 different occasions between September 21, 1907, and June 30, 1908. The mean value of the solar constant as computed for both stations is in close agreement with the mean value obtained by Abbot on Mount Wilson in 1905 and 1906.

The results of instrumental comparisons, the reduced pyrheliometer observations, and the computed values of the solar constant have been published in the Bulletin of the Mount Weather Observatory, vol. 1, parts 2 and 4.

Considerable discrepancies exist in the values of the solar constant computed from observations on different days, and even from observations at Mount Weather and at Washington on the same day. In most cases these are traceable to the unsteadiness of the atmosphere. The formula employed, in common with all formulæ with which we are familiar, assumes that atmospheric conditions are uniform during the period of observation, which usually lasts two hours. Such conditions probably do not occur in the eastern part of the United States more than ten or twelve times during the course of the year, and almost never during the summer months. It is therefore hoped that, if the new apparatus ordered proves satisfactory, arrangements can be made to obtain observations at some point in the arid Southwest, where it is believed favorable conditions prevail on a majority of the days throughout the year.

The headquarters for solar radiation investigations were transferred from the central office to Mount Weather, Va., on July 1, 1908.

UPPER-AIR OBSERVATIONS AND WEATHER FORECASTS.

In previous years upper-air observations for the study of the forecaster were telegraphed from Mount Weather to Washington at irregular intervals. During the year that ended June 30, 1908, they were telegraphed daily. The character and special value of these observations in their application to practical weather forecasting and the manner of utilizing them are illustrated by the following extracts from the general forecasts issued at Washington:

May 1, 1908.—The cold weather of the last few days has reached its climax, and will doubtless be followed within the next few days by considerably higher temperatures east of the Mississippi. The kite observations to-day at Mount Weather at an elevation of about a mile above the station showed a temperature of only 10° above zero, or a fall of 25° in the last twenty-four hours. This would seem to indicate a slow rise on the surface during the next twenty-four hours.

May 6, 1908.—Since the beginning of the present rainy spell it has been impossible to get the kites at Mount Weather more than 3,200 feet above the mountain, thus indicating the existence at that level of a considerable stratum of calm or light winds and a temporary suspension of the characteristic west-east movement of the upper air in these latitudes. This is the probable explanation of the failure of the Mississippi Valley storm to advance eastward. To-night's reports show, however, a well-developed storm center in southern Indiana, with a tendency to move northeastward by way of the St. Lawrence Valley. Should it move as indicated, the great cloud blanket that has covered the country east of the Mississippi since Monday last will be lifted by Friday morning, and higher temperatures will prevail.

May 18, 1908.—The kite flights at Mount Weather during the last few days have reached only small elevations above the mountains, thus indicating, as on a previous occasion during the month, the existence of a considerable stratum of calm or light winds about 2,000 feet above the mountains, through which the kites can not pass. The surface winds in both cases were from the east.

A return of the stagnant conditions that prevailed during the latter half of May was noted on June 3. In each instance unsettled and rainy weather was experienced over the eastern portion of the country and the surface winds were from the eastern quadrants.

June 15, 1908.—The kite flight at Mount Weather to-day reached an altitude of nearly 2 miles above the station, at which elevation the temperature was 31°, while at the surface it was 65°. High northwest winds and heavy rain followed the flight.

The rains and cooler weather that reached the Atlantic States on this date were in accord with a forecast issued June 9.

June 22, 1908.—To-day the kite at Mount Weather passed through a warm stratum of air at an elevation of 1,500 feet above the station, where the temperature was 75°, or 7° higher than at the surface. The warm air did not extend much above 1,500 feet, and from that elevation up to 5,700 feet above the station the temperature fell 15°.

On this date a warm wave covered the country east of the Mississippi. On the following date, June 23, there was not sufficient wind to fly a kite and it became necessary to use a captive balloon. The latter showed an almost uniform decrease in temperature from 84° at the surface to 61° at an elevation of 7,800 feet.

June 20, 1908.—During the kite flight at Mount Weather to-day an altitude of 16,300 feet was reached, at which elevation the temperature was 20°, while at the surface it was 74°, with westerly winds.

The weather map to-night is of the hot-weather type—high pressure in the southeast and low over the north and northwest. As a consequence temperatures are much above the seasonal average over the entire country east of the Rocky Mountains, except where local thunderstorms have afforded temporary relief.

July 3, 1908.—The vigorous circulation of the air in the higher levels above Mount Weather that characterized the closing days of June has now given way to stagnant conditions that make it necessary to use captive balloons instead of kites in sounding the air. The ascension to-day showed a uniform fall in temperature from 76° at the surface to 58° at an altitude of 6,400 feet above sea level.

July 13, 1908.—The kite flights on Mount Weather to-day showed, as on a previous occasion under similar conditions, a marked temperature inversion about 1,500 feet above the earth's surface. At that level it would seem that nocturnal radiation is not effective in lowering the night temperature as on the earth's surface.

The outlook is for slowly moderating temperature over the eastern half of the country during the next two days. There are no present indications of another period of excessive heat.

July 17, 1908.—Since the breaking up of the warm spell the upper air currents have been unusually active. On the 15th the kites at Mount Weather broke away in high winds at an elevation of 8,400 feet above sea level. On the 16th an elevation of over 17,000 feet was reached, with brisk northwesterly winds and a temperature of 15° above zero. At the surface the temperature was 65°.

On July 22 a zone of light variable winds was again shown at an altitude of about 1,000 feet above the station, the first condition of this character observed in about ten days. A captive balloon that passed through the calm zone indicated the prevalence of westerly winds at an altitude of 1 mile above the station and a temperature of 57° as compared to 77° at the surface. As in previous cases noted, the presence of a stratum of light winds or calm at an elevation of 1,000 to 1,500 feet above the station attended generally unsettled and rainy weather over the eastern portion of the United States.

July 30, 1908.—Hitherto the kite flights at Mount Weather have uniformly shown that easterly winds over that region are quite shallow, none of them extending more than a mile above the mountain. On Thursday, for the first time, at an altitude of about 2 miles above the station, rather strong easterly winds were found, thus indicating a suspension of the ordinary west to east drift in these latitudes.

At this time a storm that had moved slowly northward from the subtropical region of the Atlantic was central near the North Carolina coast, with reported barometer 29.22 inches at Wilmington. The unusually strong and high drift of easterly winds referred to was doubtless due to the exceptional strength of the air currents in the northern quadrants of this storm. The high winds that followed the northward movement of the storm center carried away three kites at an altitude of more than 3 miles on August 1.

August 20, 1908.—The kite flights on the 18th, 19th, and 20th reached an altitude of about 3 miles above sea level. The temperature at that height on the 18th was 30°, falling on the 19th to 28°, and on the 20th to 24°. The fall at the upper level was felt nearly forty-eight hours before it reached the surface.

August 27, 1908.—On the 25th the kites at Mount Weather passed into a dense layer of cloud and fog, which enveloped the mountain and probably extended more than 6,000 feet above it. The air temperature at the upper level was nearly the same as at the surface. The winds were north-northeast at the surface, shifting to northeast aloft, such as would be required with a storm center off the south Atlantic coast.

Beginning August 23, a barometric depression had occupied the Gulf States, and on the 25th the center of disturbance was over the east Gulf States and the low area extended thence over the South Atlantic coast. To the north and northeast was an area of high barometer. This distribution of pressure extending over a two or three day period caused a prolonged drift of northeasterly winds over the Middle Atlantic States, and, as shown by the Mount Weather observations, equalized temperatures in the air currents to an elevation of more than 6,000 feet. This was a period of exceptionally heavy rains that gradually extended from Georgia northward to New England.

The daily observations that have been secured during the past year at a nearly uniform altitude of about 1 mile above the Mount Weather station and the occasional soundings of the atmosphere to much greater heights have been of particular interest to the forecaster. A study of data that have been obtained, and that will be secured by improved apparatus, will undoubtedly reveal elements of cause in the practically unexplored regions of the upper atmosphere that will account for many phases of weather and climate that observations taken at the surface of the earth do not indicate or presage.

FORECASTS AND WARNINGS.

Attention has been given during the past year to isobaric charts based upon telegraphic reports received daily from selected stations throughout the Northern Hemisphere. Forecasts for periods of about a week in advance were begun experimentally, and during the last three months of the year they were prepared for publication. The following of these forecasts are presented for the reason that they dealt with notable abnormal conditions:

> WASHINGTON, D. C., *Saturday, April 18, 1908.*
>
> Forecast for the week beginning Sunday, April 19, 1908.
>
> For the States of the Missouri, extreme upper Mississippi, and Red River of the North valleys, where little or no rain has fallen, a season of showery weather will be inaugurated by the middle of the week. In the Gulf States and lower Mississippi Valley the excessive rains of the past week will give way to a period of more settled weather.

Heavy showers set in over the north-central districts referred to during the night of Wednesday, April 22, and precipitation continued in that region during the following three or four days. In the South Central States the prolonged period of rain ended on the 21st.

The Cheyenne Tribune of May 4, 1908, had the following editorial concerning the forecast of May 2 for the following week:

> The weather man down at Washington has made an excellent guess. Saturday he gave to the Associated Press the following:
>
> "The rains of the week beginning Sunday, May 3, will cover the principal agricultural districts from Canada to the Gulf of Mexico. From May 3 to 5 an area of general rains will advance from the Pacific to the Atlantic coasts, reaching the Atlantic coast Monday night or Tuesday * * *."
>
> The storm Cheyenne is now enjoying arrived very promptly on schedule, and is worth more to Laramie County than can be measured in dollars and cents. The precipitation is probably general over Wyoming.

The rains referred to broke a drought in Wyoming and eastern Colorado that was rapidly becoming serious.

On Monday, June 15, the following was issued:

> The period of persistent heavy rains of the last two weeks that have caused destructive floods in the Middle Western States will end by Thursday. Temperature will rise in the Plains States and central valleys after Tuesday and the warmer weather will reach the Atlantic States about the close of the week. Next week will open warm over the eastern portion of the country.

The heavy rains of the Middle Western States practically ceased Thursday. Following the termination of the rain period the first well-defined warm wave of the season set in over interior districts and extended to the Atlantic coast by the close of the week. A forecast dealing especially with this warm wave was issued on the morning of Monday, the 22d:

> The warm wave that now covers the country generally east of the Rocky Mountains will break over the Plains States Tuesday, over the Mississippi Valley and the western Lake region Wednesday, in the Ohio Valley and eastern Lake region Wednesday night, and in the Atlantic States Thursday. Local rains and thunderstorms will attend the advent of the cooler weather in the several sections named. Moderate temperature will be experienced over the eastern portion of the country during the closing days of the week.

This forecast, like preceding ones, was closely verified. The value of accurate forecasts for this period to agricultural and business interests can not be measured, and the success that has attended the experimental and published forecasts will justify this office in making weekly forecasts a regular feature of its work. Their inauguration will mark a most important advance in the practical application of meteorological science. Using as a basis of calculation isobaric lines of the Northern Hemisphere, forecasts may, on occasions, be safely made for periods greater than one week. The next advance in the art of forecasting will be marked by a still further extension of the forecast period.

All severe storms on the American coasts and lakes and severe cold waves and frosts that visited any portion of the United States during the year were successfully forecast. No important storms of tropical origin visited the United States coasts. The following dispatch from Kingston, Island of St. Vincent, British West Indies, dated September 20, 1907, indicates the character of disturbances that occurred in that section during the prevalence of low barometric pressure over the tropical regions of the oceans:

> Recent advices from the Weather Bureau at Washington were verified in a remarkable manner. A disturbance east of the Windward Islands, which had been announced as probable, developed yesterday into a thunderstorm of great severity. Exceedingly low thunder clouds hung over St. Vincent, and the lightning was fearfully vivid. Several casualties occurred. Similar storms have been experienced in the northern islands.

The association of upper air observations made at Mount Weather with the practical work of weather forecasting is receiving special attention, and progress is being made in determining the relation of cause and effect that exists between conditions observed in the upper strata and certain types of normal and abnormal weather.

INSTRUMENTS.

For many years the operations of the Instrument Division have been governed by a fixed policy of slowly bringing the instrumental equipment of all regular stations up to a certain uniform and high standard. This work was practically completed a year ago, as stated in my last annual report.

No new stations were established during the year closed June 30, 1908, and the ordinary resources of the Instrument Division thus became available for the betterment of station outfits that had been in service for many years.

Partial equipments, consisting of barometers, thermometers, rain-gauges, and shelters, have been issued to special observers at Greenville, Me.; Leadville, Colo.; Wallace, Idaho; Jackson, Miss.; Sitka, Alaska, and Marshfield and Siskiyou, Oreg., from each of which daily telegraphic reports are rendered at the nominal compensation of $25 per month.

SEISMOGRAPHS AND EARTHQUAKE RECORDS.

The seismographic records were constantly maintained during the year. A new instrument of high magnification (120 times), designed by Professor Marvin, was installed in November and has since been in successful operation. A detailed description of this seismograph was published in the Monthly Weather Review for November, 1907.

In the latter part of the year a seismograph of European manufacture for recording vertical motion was purchased and temporarily installed. This instrument, however, is so seriously disturbed in its action by variations of temperature, air currents, etc., that its installation requires exceptional surroundings, which are not now available. It is hoped Congress will favor the extension of seismological work along the lines indicated in my last annual report. In the meantime these important studies are restricted to the simple maintenance of the daily records from the instruments now installed.

NEW WORK.

The work of inventing new apparatus to meet the ever-increasing demands of the Bureau may be summarized under the following items:

(1) CHART AND INSTRUMENT KIOSK.—A suitable means of taking meteorological observations, especially of temperature and humidity, near the street levels, and thus representing more nearly the conditions experienced by pedestrians and the public generally, has long been felt. To meet this need it seemed practicable to expose instruments, accompanied by climatic charts, weather maps, and forecast cards, in a shelter of appropriate design, located at some favorable point or points in the business and news centers of every large city. Prof. C. F. Marvin, in charge of the Instrument Division, was instructed to work out the details of such a scheme. The problem involved not only the design for the kiosk itself, which must provide proper exposure for the instruments and charts and protect them from molestation, but also new instruments of a construction adapted to satisfy the special conditions. The instruments comprise special forms of maximum and minimum thermometers, air thermometer, hair hygrometer, thermograph, and a special type of tipping-bucket rain-gauge with dial indicator. All of these have been successfully devised by Professor Marvin.

(2) RECORDING HYGROMETERS FOR STATIONS.—The moisture content of the air constitutes one of the most important meteorological elements requiring observation, yet its automatic registration in an accurate manner has thus far baffled the genius of inventors. An American manufacturer has made important improvements to an instrument for this purpose. A few have been tried at stations selected for the purpose of securing the most satisfactory tests. Gratifying results have been obtained, but a longer test is necessary.

(3) TELE-THERMOSCOPES.—The local offices of the Weather Bureau in large cities are called upon by telephone or otherwise many times daily for temperature data, especially during periods of exceptional weather conditions, and, for many years, a type of instrument has been in demand that would record or indicate in the main office room the true temperature outside. In the absence of such an instrument observers have been obliged to make frequent trips to the roof, which is often at a considerable distance. Within the past year a type of apparatus capable of showing but not recording the air temperature has been introduced to meet these needs; it is of such a character that it gives promise of meeting the exacting requirements of the Bureau with regard to accuracy. The thermometer is a protected coil of wire, the electrical resistance of which varies with temperature. The indicator, which is located in the office, is a device that determines the electrical resistance of the coil and indicates the corresponding temperature. Ten of these instruments have been installed.

Among the newer types of instruments that have been introduced in recent years, mention has been made in previous reports of automatic gauges for recording or indicating river stages. The installation of one of these at Pittsburg was completed during the past year, and work was begun on the mounting of a similar gauge at Cincinnati, Ohio, on the north pier of the Covington and Cincinnati suspension bridge. The introduction of this gauge will give us what we have been unable to obtain heretofore, namely, the extreme flood stages of the river. The extreme range of the Ohio River at this point amounts practically to about 75 feet. The new gauge will automatically indicate in the office of the observer, no matter what its distance from the river, all stages above 18 feet.

RIVER AND FLOOD SERVICE.

The months from February to June, inclusive, of the present year were characterized by frequent floods, some of them of grave character, taxing to the utmost the resources of the Weather Bureau to deal successfully with them.

The Ohio Valley was the chief sufferer, with floods of marked character during each of the four months from February to May, inclusive. The floods of May were not limited to the Ohio River, but extended throughout the entire Mississippi watershed above the mouth of the Ohio River. In the month of June general and destructive floods occurred over the same watershed, except the Ohio River portion, and the fortunate failure of the Ohio simultaneously to be in flood stage prevented the greatest flood in the history of the lower Mississippi River. As it was, the river at New Orleans reached a stage of 20 feet on June 19 and 22, only 0.4 foot below the great high-water stage of April 6 and 7, 1903. At the close of the year the river stood at 19.6 feet on the gauge, having been above the flood stage continuously since March 9.

The most destructive floods of the year occurred in the Red and the lower Arkansas rivers and their tributaries in the State of Oklahoma, and in the Trinity and Brazos rivers of Texas, the losses in Texas alone amounting to not less than $5,000,000.

These floods were forecast with the same accuracy that attended those of former years, and in some instances with an exactness much beyond that ever before attained. Particular attention is invited to the work along the Red and lower Mississippi rivers, where the warnings, given in detail two weeks in advance, were so exact as to leave practically no percentage of error. Numerous newspaper editorials and several resolutions of thanks from representative bodies testified to the public appreciation of the work of the Weather Bureau.

With each succeeding year the development of agricultural operations and the extension of business interests, more or less dependent upon river stages, necessitate some broadening of the field of activity of the River and Flood Service, and during the present year new work has been undertaken as follows:

(1) The establishment of a continuous flood-warning service, operating day and night in times of flood, in that portion of the State of West Virginia bordering on the Ohio River.

(2) The establishment of a new river district center at Binghamton, N. Y., with territory comprising that portion of the watershed of the Susquehanna River at and above Binghamton. This territory was formerly a portion of the Harrisburg, Pa., district.

(3) The opening of new river stations in the watershed of the upper Cumberland River, in the interest of navigation and the lumber industries.

(4) The opening of several new stations at scattered places throughout the country, in order to secure increased efficiency in the flood-warning service. Realizing the fact that the art of river forecasting is dependent upon the intelligent use of data of diverse kinds, and that the exigencies of the Weather Bureau service frequently render it impossible for officials in charge of river districts to systematize and preserve for future use their knowledge of the regimen of the rivers in their districts, the river and flood branch of the central office at Washington has begun, in cooperation with the district officials, an exhaustive study of the problem. The Ohio River and its principal tributaries as far south as Cincinnati, Ohio, have thus far been studied and the results in elaborate form have been transmitted to the officials in charge of the various districts for actual use in river forecasting. It is hoped that the scheme for the entire Ohio River, and possibly a portion of one for the Mississippi River, can be completed within another year. The work is necessarily slow, as it involves the discussion of a large amount of data.

The new field work contemplated during the coming year is largely suggested by the flood problems of the present year, as well as by requests for increased service from Members of Congress, citizens, corporations, and associations of various kinds. Should our resources permit, it is proposed to introduce flood-warning service along the Oklahoma tributaries of the Arkansas River, and to extend somewhat the present service on the Red and Neosho rivers, and possibly the upper Arkansas River. In connection with the latter project it may become necessary to establish a new river district center at Wichita, Kans. Request has also been made for additional service along the upper Missouri River and its tributaries, and the matter will be given attention during the coming low-water season.

No definite suggestions can be made at this time regarding proposed work during the fiscal year ending June 30, 1910. It may be possible by that time to take up the question of river service over the Yukon River watershed in the interest of navigation, and also the expansion of the service that will be necessary on the Ohio and lower Mississippi rivers in order to meet the requirements of inland water transportation.

CLIMATOLOGICAL DIVISION.

During the year ended June 30, 1908, the Climatological Division was charged with (1) the collection and publication of climatological data, and (2) the distribution of forecasts and special warnings. Under the first-named heading may be classed:

(*a*) Cooperative stations, of which there are more than 3,700.

(*b*) Cotton, corn and wheat, and sugar and rice region stations, and the publication of the daily bulletins (Forms Nos. 1045 and 1046–Met'l) at district centers and other selected Weather Bureau stations for the period from April to October.

(*c*) The monthly and weekly publications of the several sections of the climatological service, including the monthly snowfall bulletins of the States of the Rocky Mountain and Plateau regions for the period from December to March.

(*d*) The preparation of the national weekly and monthly weather bulletins, and the weekly snow and ice bulletins issued during the winter months.

COOPERATIVE STATIONS.

At the close of the year there were 3,761 stations of this class in operation, an increase of 77 over the number in operation at the end of the preceding year. Most of the newly established stations are in the semiarid regions of the West, special efforts having been made to place stations at the higher altitudes of the drainage basins of the streams whose waters are used in irrigating. Two hundred and sixty-three cooperative stations, the majority of which were in the eastern portions of the country, were for various reasons discontinued. During the year 237 stations were visited by section directors for the purpose of inspection. The number of stations inspected was considerably greater than during the previous year.

COTTON, CORN AND WHEAT, AND SUGAR AND RICE REGION STATIONS.

The number of cotton region stations at the close of the year was 143, or 1 less than at the close of the preceding year, 2 stations having been discontinued and 1 established. There are 137 corn and wheat region stations, 4 more than at the close of the year ended on June 30, 1907, 7 having been established and 3 discontinued during the year of 1907–8.

CLIMATOLOGICAL PUBLICATIONS.

The publications of the 44 section centers of the climatological service have continued without change. The monthly reports of all the sections have been issued with promptness, the majority making their appearance before the 20th of the month succeeding that to which they pertain. With the installation of a number of additional printing plants, the number of sections having their reports printed by contract has been reduced to 2, namely, Idaho and Hawaii, against 7 at the close of the previous year. The average date of issue of the annual climatological reports was earlier than in the year before. The weekly weather bulletins issued during the crop-growing season have been regularly published by all the sections, including Porto Rico and Hawaii. A reduction in the edition of these bulletins is noted, the total number being more than 3,000 below that of the previous year.

The following table shows for each section the number of cooperative observers, the number of weather correspondents, and the editions of the weekly weather bulletins and monthly climatological reports:

Cooperative observers, weather correspondents, and edition of climatological publications.

Section.	Number of—		Copies of publications issued.	
	Cooperative observers.	Weather correspondents.	Weekly bulletins.	Monthly climatological reports.
Alabama	38	128	500	500
Alaska	45	0	0	0
Arizona	80	55	700	700
Arkansas	65	58	525	665
California	350	50	500	700
Colorado	95	42	300	700
Florida	60	75	750	475
Georgia	42	150	650	625
Hawaii	151	53	396	458
Idaho	65	76	600	450
Illinois	90	90	780	430
Indiana	58	140	650	725
Iowa	121	700	1,900	1,800
Kansas	93	91	1,500	1,250
Kentucky	39	39	350	325
Louisiana	42	75	450	700
Maryland	51	60	300	325
Michigan	115	124	389	750
Minnesota	81	42	600	425
Mississippi	63	85	400	715
Missouri	78	110	368	381
Montana	81	85	600	600
Nebraska	140	404	760	585
Nevada	40	42	150	300
New England	150	55	350	700
New Jersey	51	55	400	325
New Mexico	78	70	450	870
New York	123	117	900	825
North Carolina	66	114	420	900
North Dakota	80	50	500	550
Ohio	96	109	650	575
Oklahoma	70	190	700	650
Oregon	93	93	300	540
Pennsylvania	87	65	320	600
Porto Rico	45	33	182	375
South Carolina	32	47	480	430
South Dakota	65	98	575	637
Tennessee	50	88	250	450
Texas	148	150	800	900
Utah	83	154	500	600
Virginia	54	94	325	950
Washington	85	45	600	850
West Virginia	55	65	900	500
Wisconsin	84	84	350	500
Wyoming	73	20	275	350
Yellowstone Park	10	0	0	0
Total	3,761	4,570	24,345	27,661

DISTRIBUTION OF WEATHER FORECASTS AND SPECIAL WARNINGS.

Diligent efforts have been made to increase the distribution along all lines, but, as in the previous year, the principal part of this work has been directed toward the dissemination of forecasts through the medium of the telephone companies, and they have responded almost unanimously to the invitation to cooperate for the benefit of their subscribers. During the year several States of the Middle West and on the Pacific slope were canvassed, and as a result a large number of telephone companies in those States are now cooperating with the Bureau in this important work.

One of the largest telephone companies operating in the Southern States, which had heretofore declined to take up the work of distribution, has fallen into line and is now giving its subscribers the benefit of the daily forecasts, through a large number of exchanges, particularly in the States of Mississippi and Tennessee.

In the States of the Middle West the telephone is largely used for transmitting forecasts, and the weather information is much appreciated. The officers of the companies state that the number of calls that come into "central" daily for the weather reports is surprising. They say that it is an advantage to them to have the opportunity of distributing the information free, as such action aids in securing more subscribers. Some officials, in fact, are enthusiastic in their commendation. A special correspondent of the New York Evening Post writes from Kansas City, Mo., as follows:

> Little wonder that every day's weather predictions are awaited with interest. Early in the morning in the central telephone stations of the grain counties the calls come in to know "What does the weather man say?" The farmers' lines are kept busy answering these calls until nearly noon. So insistent is the demand for this news that many of the companies send out a general call for all subscribers at 9 o'clock, and read the bulletins.

The greater proportion of the telephone companies are now publishing in some prominent place in their directories the following notice:

> Subscribers of this company may obtain the daily forecasts and special warnings of the Weather Bureau of the United States Department of Agriculture from their respective exchanges after 11 a. m., eastern time. These forecasts usually cover the thirty-six hour period ending at 8 p. m. of the following day.

The following table gives, in detail, the distribution of forecasts and special warnings for the various States and Territories:

Distribution of daily forecasts and special and emergency warnings.

State or Territory	At Government expense			Without expense to United States by—				
	Forecasts and special warnings.	Special warnings only.	Emergency warnings.	Mail.	Rural delivery.	Telephone.	Railroad train service.	Railroad telegraph.
Alabama	33	2	139	1,124	661	4,715	0	96
Arizona	8	0	0	152	0	5,911	0	0
Arkansas	27	7	102	636	666	15,837	0	15
California	124	12	0	1,379	4,086	52,986	0	9
Colorado	19	60	39	396	1,748	32,830	0	0
Connecticut	16	0	49	1,401	50	71,292	131	0
Delaware	10	0	0	95	1,025	4,865	0	30
District of Columbia	0	0	0	1,419	0	5,700	0	1
Florida	30	131	32	1,068	263	5,329	0	58
Georgia	43	33	241	1,782	1,307	21,197	0	214
Idaho	23	0	0	533	255	13,559	0	0
Illinois	121	0	468	4,301	2,808	457,052	0	17
Indiana	114	1	208	2,117	1,935	154,279	0	76
Iowa	143	6	400	1,996	3,522	107,484	25	0
Kansas	87	1	186	1,266	1,915	202,415	0	15
Kentucky	40	34	96	1,648	720	25,038	0	1
Louisiana	36	36	61	680	340	2,224	0	9
Maine	16	1	40	1,009	877	12,146	0	0
Maryland	25	4	42	2,131	1,096	6,546	0	80
Massachusetts	23	10	63	3,262	210	8,950	77	0
Michigan	86	3	379	5,484	373	408,759	279	239
Minnesota	83	5	196	2,417	4,300	144,601	0	18
Mississippi	41	7	118	1,061	958	35,555	0	6

Distribution of daily forecasts and special and emergency warnings—Continued.

State or Territory.	At Government expense.			Without expense to United States by—				
	Forecasts and special warnings.	Special warnings only.	Emergency warnings.	Mail.	Rural delivery.	Telephone.	Railroad train service.	Railroad telegraph.
Missouri	37	0	240	3,318	2,231	306,329	0	26
Montana	13	19	18	441	50	10,311	0	0
Nebraska	82	2	221	1,170	406	155,465	0	0
Nevada	6	0	0	64	0	413	0	0
New Hampshire	20	0	34	794	1,429	2,285	14	0
New Jersey	30	18	45	1,218	0	7,215	0	195
New Mexico	8	0	0	125	0	5,361	0	17
New York	143	46	365	7,778	2,392	272,332	176	143
North Carolina	74	14	189	712	2,795	24,421	0	0
North Dakota	21	0	99	194	2,009	31,616	0	0
Ohio	100	96	312	6,378	1,474	500,909	24	26
Oklahoma	36	1	17	661	1,151	7,313	0	116
Oregon	11	0	0	482	435	5,457	0	0
Pennsylvania	78	11	367	4,088	1,718	153,210	1	534
Rhode Island	2	0	12	471	0	898	12	0
South Carolina	35	8	109	914	672	3,990	0	40
South Dakota	61	13	77	734	415	31,221	0	0
Tennessee	36	5	291	1,391	1,676	16,811	0	3
Texas	132	49	240	1,158	2,961	52,651	0	60
Utah	9	35	0	387	1,041	32,333	0	0
Vermont	16	0	46	471	466	10,428	12	8
Virginia	61	3	96	1,512	1,848	29,535	101	71
Washington	26	0	0	777	1,421	2,600	0	0
West Virginia	28	7	55	906	7	29,049	0	16
Wisconsin	116	7	298	2,542	2,296	54,809	0	0
Wyoming	5	3	8	111	0	6,835	0	0
Total	2,334	690	5,998	76,154	58,008	3,553,067	852	2,139

MARINE DIVISION.

This division collects meteorological information pertaining to the oceans from naval and merchant marine vessels, plots the data (pressure, temperature, wind, and weather) on daily synoptic charts for study and for the preparation of monthly summary charts, and compiles in tabular form meteorological data for use of the Hydrographic Office of the Navy in the preparation of the Pilot Charts.

The normal pressure and temperature inset charts, tables showing the percentage of fog and gales, and wind roses showing the direction and force of the prevailing winds, are printed monthly for all coast stations and each 5° square of latitude and longitude on the Pilot Charts of the North Atlantic and North Pacific oceans.

The meteorological data are obtained through a system of cooperation on the part of vessel owners and captains and the United States naval vessels, the Bureau furnishing in lieu of other compensation such available publications as may be of service. During the last year 1,608 vessels, hailing from every port and flying the flag of every nation, cooperated with this Bureau. Meteorological reports and publications were distributed to all such cooperating vessels, to local Weather Bureau offices, and to American consulates. A number of the forms and charts used are kept on hand at local stations and American consulates for filling requests.

Twenty-five local Weather Bureau offices are equipped to assist in the marine meteorological work. The stations at Portland (Me.), Boston, New York, Philadelphia, Baltimore, Norfolk, Wilmington, 'eston, Savannah, Jacksonville, Tacoma, Seattle, Portland

(Oreg.), San Francisco, San Diego, Honolulu, and Washington are supplied with marine barometers.

PILOT CHART, NORTH PACIFIC OCEAN.

Beginning with the month of January, 1908, the meteorological data for this chart have been entirely revised, the averages or normals for pressure, temperature, wind (direction and force), percentages of gales, trade-wind limits, and storm tracks being given. These data have been computed for each 5° square of latitude and longitude, and the result of this work is published on the Pilot Chart issued by the Hydrographic Office, Navy Department.

PILOT CHART, NORTH ATLANTIC OCEAN.

The revision of the meteorological data for this chart commenced with the month of July, 1908, and has been continued for each succeeding month.

A chart giving the prevailing winds and calms, with gale percentages, is furnished to the Hydrographic Office forty days in advance of the date of publication, while the inset chart (pressure and temperature), trade-wind limits, storm tracks, percentage of gales and fog, and a statement of average conditions of wind and weather, are delivered thirty-five days in advance. It will be necessary to make a revision of the wind-rose data, prevailing direction and force of the wind, for the North Atlantic and North Pacific oceans for the months prior to August.

INDIAN OCEAN.

All meteorological data received from vessels sailing this ocean are dispatched every six months to Simla, India, where they are copied for the use of the Indian meteorological department and then returned to this Bureau.

FOG.

At the request of Mr. James White, geographer, Department of the Interior, Ottawa, Canada, made on March 24, 1908, a chart for each month, showing the frequency of fog in the Gulf of St. Lawrence and on the great circle route between Belle Isle and the north of Ireland, was prepared and furnished for the period 1901–1907.

WIRELESS TELEGRAPHIC WEATHER SERVICE.

On September 20, 1907, the Marconi Wireless Telegraph Company, and the foreign and American agents of the vessels cooperating with this Bureau, by transmitting meteorological observations made at sea, were informed that this service is suspended for the present.

The official at San Francisco has arranged through this Bureau and the Quartermaster-General of the Army to have the Army transports plying between that port and Manila send wireless messages containing weather reports to that station. This work will be taken up by the transports as rapidly as wireless equipments are installed. It is the purpose to utilize the reports in forecasting the weather conditions for the coast.

The official at Portland, Oreg., has completed arrangements with Mr. W. J. Smith, manager of the Marine Transportation Company, to receive each morning and evening observations of pressure, temperature, wind, and weather from the following ships plying between Portland, Seattle, Alaskan ports, and San Francisco, viz, *Humboldt*, *President*, *Governor*, *Rose City*, *G. W. Elder*, *Roanoke*, and *City of Pueblo*.

VESSEL-REPORTING SERVICE.

In addition to the meteorological work, the officials in charge of the stations at Block Island, Cape Henry, Jupiter, Sand Key, Southeast Farallon Island, North Head, and Tatoosh Island are required to report all passing vessels, wrecks, marine disasters, and other casualties, and transmit all communications between masters, owners, underwriters, and others interested. The stations at Cape Henry, Jupiter, and Sand Key are equipped for signaling and receiving messages by the international code and for transmitting by telegraph all messages received from passing vessels. Sand Key is also prepared to receive and transmit messages at night by flash-light signals. During the last fiscal year these stations received, and transmitted to the vessel owners and others, 24,319 messages. During this time but two complaints were received, and these upon investigation proved unfounded. The Cape Henry station reported the passing of 17,624 vessels without an error being charged to it. The work done at this station was highly commended by the Maritime Exchange of New York City and by Commander B. M. Berry, commandant of the navy-yard at Norfolk.

LIBRARY.

Attention is called to the fact that the Weather Bureau has gradually collected a meteorological library that is probably unrivaled throughout the world. The accessioned books and pamphlets number about 28,000, including nearly complete files of the publications of all the meteorological services and independent observatories of the world (including the foreign daily weather maps); files of all scientific journals that devote more or less attention to meteorology, and a large collection of meteorological and physical memoirs, textbooks, and reference books. Every effort is made to obtain promptly, by gift, exchange, or purchase, a copy of each new publication bearing on meteorology. Current catalogues and bibliographies are carefully searched for the titles of such publications, and an extensive correspondence is maintained with authors and publishers.

All works in the library are fully catalogued by authors, and about half (comprising all the additions of recent years) are also catalogued by subjects. A very important part of the work of the library consists in cataloguing, under both author and subject, the meteorological articles contained in the current numbers of nearly a hundred scientific periodicals, including the transactions and proceedings of societies. This task is justified by the value of the bibliography that is thus accumulating, and that is now more frequently consulted than the catalogue of books.

At least two-thirds of the publications received in the library are in foreign languages, in about the following order of frequency: German, French, Spanish, Italian, Russian. Dutch, Portuguese, Roumanian, Swedish, Dano-Norwegian, Magyar, Polish, Czech, Finnish, Japanese.

In addition to the general library of the central office, the Bureau maintains small libraries at 191 stations. All of these libraries are under the supervision of the library at Washington, which purchases and issues all books for stations. During the past year there has been a marked increase in the number of highly technical works issued to stations, including the more important works in foreign languages. This applies especially to the stations at which educational work is carried on and to the research observatory at Mount Weather. The latter now has the nucleus of an excellent meteorological and physical library, and receives a large list of scientific periodicals.

The library prepares for each number of the Monthly Weather Review a list of current papers bearing on meteorology and seismology, a list of recent additions to the library, and a column of meteorological news, notes, and abstracts. The duties of the supervising examiner, referred to elsewhere, form a considerable part of the work of the librarian.

During the past year the librarian, Mr. H. H. Kimball, has been occupied with important researches on solar radiation, and most of the duties of librarian have been performed by the assistant librarian, Mr. C. F. Talman, who also assumed the duties of supervising examiner on May 22, 1908, and became librarian by promotion on July 1, 1908.

EXAMINATIONS FOR PROMOTION.

The transfer of the examination in essay writing from the first to the second group of examinations, referred to in my last report, has made possible the advancement of many of the younger employees who would otherwise have been retained for an indefinite time in the lowest grades. The ability to write a satisfactory essay, conforming to the rules of good taste as well as grammar, does not depend upon the study of a text-book, but is a question of general education and culture. This examination is too severe a test to impose upon the younger men, whose duties are generally performed in comparative obscurity, under the supervision of others, but is an excellent means of ascertaining the fitness of employees to fill the more important and independent positions.

The total number of examination papers received during the year was 236, as compared with 158 during the preceding year. Following is the record in detail:

Number of examination papers received.

Subject.	1907.		1908.		Total.	Passed.	Failed.
	August.	November.	February.	May.			
English grammar	4	8	13	12	37	30	7
Arithmetic	7	9	8	16	40	33	7
Elementary meteorology	6	10	5	13	34	30	4
Algebra	4	7	5	10	26	15	11
Physics	3	2	6	9	20	19	1
Trigonometry	3	5	5	5	18	15	3
Essay writing	3	1	7	6	17	13	4
Astronomy	1	2	8	4	15	12	3
Plant physiology	2	5	4	6	17	16	1
Advanced meteorology	2	2	4	4	12	12	0
Total	35	51	65	85	236	195	41

METEOROLOGICAL RECORDS.

The regular work of the Division of Meteorological Records has been carried on in the usual way throughout the year. It consists of checking the meteorological reports, and discussing the same, and preparing reports for publication in the Monthly Weather Review and the Annual Report of the Chief of Bureau. Nearly 2,000 letters of inquiry on various topics, received from the public, have been answered, the matter furnished including many certificates of official data for use in the courts. A new series of climatological papers is being prepared, in which the records of precipitation, temperature, dates of the first and last killing frosts, and prevailing wind directions are collected, the precipitation tables including all available data since the year 1871. These reviews are made comprehensive for small sections of the United States, which it is intended gradually to cover in this manner. The papers will be of value to agriculturists, engineers requiring data on water resources, and other citizens who seek information regarding the climate of the several sections.

WATER RESOURCES.

A demand for a better knowledge of the water resources of the United States has become so urgent as to make it advisable to put forth special efforts to supply the necessary data to the public. In the arid and semiarid regions of the West these consist primarily in securing the amount of precipitation from rain and snow in the high levels of the mountains, from which are derived the waters that are used in the storage basins and the irrigation projects now undergoing rapid development. It is a difficult problem to secure regular and accurate observations of the amount of snowfall in the remote regions of the mountains, where there are very few inhabitants, but a special effort will be made by the Weather Bureau to extend the range of observations into the high levels of the mountains. A plan has been perfected to cooperate with the Forest Service of the Department in securing these observations. The field work of that Service is of such a nature as to render the cooperation of its officers of value in executing this extension of meteorological observations.

The action of the forests on the conservation of the water resources of the West has so many features of a strictly meteorological character in connection with it that it seems desirable to cooperate with the Forest Service in the scientific problems which arise in this connection. The Forest Service is planning to establish several high-grade laboratory stations for the study of such problems, and the meteorological conditions in relation to precipitation, evaporation, and the storage of water will have an important place in its programme. The Weather Bureau proposes to supply the necessary meteorological apparatus and give what assistance it can of a more technical nature regarding the problems under consideration.

It is furthermore proposed to cooperate with the Bureau of Plant Industry in determining the locations or habitats most favorable for the growth of valuable plants, as the date or fig, and other selected types, in the arid and semiarid regions of the West. It will be an economical plan to determine the exact meteorological conditions in selected places, where it is proposed to try the several types of plant life, in order that suitable information may be obtained before undergoing the expense of plant cultivation. A small amount of preliminary work has been begun at the Government date farms at Indio and Mecca, southern California, in cooperation with the Bureau of Plant Industry, and it is expected that such work will be extended as appears to be advisable.

EVAPORATION STUDY.

In addition to measuring the water resources of the mountains, it is necessary to determine the amount of evaporation in the lower levels, where the storage basins are located. The amount of evaporation in the driest portions of the country, as in the Colorado Desert, may amount to as much as 8 feet of water annually, although it differs greatly according to circumstances. The process of evaporation in nature is very complicated, and especially over a body of water in the open, swept by various winds and subject to great changes of temperature, as between day and night, cloudy and fair weather, winter and summer, the laws are so complex as to have hitherto baffled the researches of many investigators. The importance of securing much more reliable information on this subject has made it desirable to renew the attack upon the problem. The formation of the Salton Sea in the Colorado Desert, by the overflow of the Colorado River during the year 1906, affords a favorable laboratory on a large scale at which to make the proposed research on evaporation. A preliminary study on this subject was conducted by Professor Bigelow in the summer of 1907, at Reno, Nev., for the purpose of securing sufficiently adequate knowledge of the phenomenon to permit a proper planning of the campaign at the Salton Sea. It was shown that pans evaporate at very different rates over the same body of water, and that the rate of evaporation is dependent upon the characteristics of the blanket of invisible vapor that overlies every large body of water.

It is not proper to infer that the evaporation over a lake is the same as that over an isolated pan away from the water. The blanket of vapor tends to conserve the water in the lake, and it may be that the lake evaporates at only five-eighths the rate of an isolated pan. While a pan in the Colorado Desert may evaporate at the rate of 8 feet a year, it now seems as if the Salton Sea were evaporating at the rate of only 5 feet a year. The necessary plant will be installed at the Salton Sea during the summer of 1908, and it is hoped that by continuing the observations for two or three years a satisfactory law covering evaporation generally may be secured. The problem is one of unusual difficulty from several points of view, but its practical value is such as to justify a serious effort to resolve it. The plan of cooperation with the other Bureaus of the Government has been enlarged to include the Reclamation Service, and the water resources branch of the Geological Survey, which are especially interested in evaporation at the reservoirs, not only of the arid West but in the eastern districts of the country. During the summer of 1908 several plants for the measurement of evaporation will be installed at the reservoirs of the Reclamation Service, and if practicable some other reservoirs in the central and eastern districts will be included. It is important to measure the evaporation in different climates on a uniform plan in order that a comprehensive law may be deduced.

Professor Bigelow, who is in charge of the Records Division, has made some studies on the laws of vortices that are applicable to the explanation of the phenomena of tornadoes, waterspouts, hurricanes or typhoons, and land and ocean cyclones. It is especially important that the theoretical side of meteorology be developed, because the interpretation of the observations must remain less fruitful until the laws controlling the physical processes in the atmosphere are correctly understood.

THE MONTHLY WEATHER REVIEW.

The Monthly Weather Review has continued to be published regularly within about six weeks of the close of the month to which its data refer. It contains the fundamental climatological averages of the month for all Weather Bureau stations, together with eight charts illustrating the geographical distribution of storms, temperature, sunshine, wind, rain and snow, and river floods. The chapters contributed by the Forecast Division and the Records Division give further details relative to these subjects. The discontinuance of the Semiannual Chart of the Great Lakes has rendered it appropriate to publish in the Monthly Weather Review some of the data formerly given on that chart. The remarks furnished by the Forecast Division relative to long-range weather forecasts have been especially appreciated. The opening chapter of the Monthly Weather Review has always given a general summary of the weather of the current month, but this review now takes a wider range. The introduction of the map showing international weather reports has called attention to the persistent relations between American phenomena and those of Europe and Asia, which relations have justified general forecasts for a week or ten days in advance, the accuracy of which is stimulative to further work along that line; articles on this subject in the Monthly Weather Review have excited wide attention.

The Chief of Bureau has acknowledged the kind cooperation of numerous meteorologists throughout the world who have sent important articles to the columns of the Monthly Weather Review.

THE TEACHING OF METEOROLOGY.

In pursuance of the policy of the Bureau to aid in eradicating the superstitions everywhere prevailing with regard to the weather, the officials of the Bureau are encouraged in giving popular lectures or explanations, and, when practicable, offering systematic courses of instruction. The minor courses for the benefit of high schools have been numerous and are recorded in detail in the successive numbers of the Monthly Weather Review. The colleges at which regular courses of instruction were given by Weather Bureau officials, in addition to their regular station duties, were as follows:

Seattle, Wash., University of Washington, G. N. Salisbury.
Syracuse, N. Y., Syracuse University, M. R. Sanford.
Raleigh, N. C., Agricultural and Mechanical College, A. H. Thiessen.
Peoria, Ill., Bradley Polytechnic Institute, D. A. Seeley.
Northfield, Vt., Norwich University, W. A. Shaw.
New Haven, Conn., Yale University, L. M. Tarr.
Madison, Wis., University of Wisconsin, J. L. Bartlett.
Ithaca, N. Y., Cornell University, W. M. Wilson.
Columbia, Mo., University of Missouri, Geo. Reeder.
Columbus, Ohio, Ohio State University, J. Warren Smith.
Cincinnati, Ohio, Cincinnati University, S. S. Bassler.
Canton, N. Y., St. Lawrence University, M. L. Fuller.
Burlington, Vt., University of Vermont, W. H. Alexander.
Berkeley, Cal., University of California, C. Abbe, jr.
Baltimore, Md., Johns Hopkins University, O. L. Fassig.

A method of instruction that is greatly valued consists in the exhibits and local talks at the numerous expositions that have been held during the past twenty years. The work of this nature done at the recent Jamestown Exposition has been highly spoken of. These exposition exhibits involve a heavy expense to the Weather Bureau and much work on the part of its officials, but thousands of citizens are thus reached who would never be able to visit a regular Weather Bureau station.

A novel educational feature has been introduced by the Department of Education of the State of New York, under the general title of "visual education." As a part of this system a popular lecture on meteorology, prepared by Mr. J. R. Weeks, of Binghamton, N. Y., has been adopted. This lecture, with the accompanying slides, is loaned for repetition before any school or academy.

Translations of special technical articles on the Mechanics of the Atmosphere, collected for the use of students, have been prepared for publication by the Smithsonian Institution.

The new edition of the Smithsonian Meteorological Tables, as revised by Professors McAdie, Marvin, and Abbe, was published at the beginning of the present fiscal year and copies have been furnished to such Weather Bureau stations as desire them. These tables are widely used by surveyors, meteorologists, and physicists.

The admirable collection by C. F. von Herrmann (now section director) of problems for advanced students of the physics of the atmosphere, published in the Monthly Weather Review for December, 1906, has been supplemented by a still larger collection that will be published during the coming year. These problems have received many encomiums; they illustrate the character of the instruction in higher meteorology that should be given in our colleges and universities.

The Handbook of Laboratory Experiments leading up to research in meteorology is being amplified by the editor, who expects to complete it during the coming year. It elaborates the idea of a systematic course of instruction for post-graduate students who are working on theses that should bring them the degree of master of science, or doctor of science, or doctor of philosophy, under the regulations that now obtain in all American colleges and universities.

At the present time the tendency of American educational institutions appears to be to assign meteorology to a subordinate position under geography, geology, physics, or other analogous department of learning. This radical error is not committed with regard to astronomy, chemistry, etc., and should be rectified. I wholly agree with the views expressed by my colleague, W. N. Shaw, esq., director of the Meteorological Office, London, in his comments on the life and influence of Alexander Buchan:

> Meteorology, or the physics of the atmosphere, is to be regarded as a separate scientific subject entitled to separate academic recognition. The physics of the atmosphere has its geographical aspect, but it is not a branch of geography; it has its mathematical aspect, but it is not a branch of mathematics, it has its experimental aspect, but it is not a branch of experimental physics.

TELEGRAPH DIVISION.

Extensive general repairs were made to the Port Crescent-Tatoosh Island line during the first part of the fiscal year, and the line is now in excellent order.

On November 6, 1907, the cable between Marthas Vineyard and Nantucket became heavily grounded within 2½ miles of Nantucket. After exhaustive tests it was concluded that it would be impossible to underrun and repair the cable, as it was 23 years old and was heavily sanded all the way. Permission was given to the Western Union cable ship to attempt to do so, without expense to the Government, and in the month of May, 1908, several trials were made by her, but without success. As the Marconi Wireless Company had by this time been handling all the Nantucket telegraph business for a period of more than six months, it was decided to dispose of the defective cable and short land line at public sale to the highest bidder, which was done on June 30, 1908.

The number of miles of telegraph and telephone lines now operated by the Weather Bureau is 460, inclusive of 110 miles of submarine cables.

The receipts from commercial telegrams handled during the year amounted to $2,781.57.

PUBLICATIONS DIVISION.

As in previous years, the principal work of this division has been the printing and distributing of the Washington Daily Weather Maps, Monthly Weather Reviews, Weekly and Monthly National Weather Bulletins, and, during the winter months, the Snow and Ice Bulletins. To the above list of regular publications there has been added since last report the Bulletin of the Mount Weather Observatory, a pamphlet containing about 100 pages and issued quarterly. The division has also supplied the observing stations with the requisite blank forms, maps, and forecast cards, and has directed such binding and miscellaneous printing as was authorized for the several divisions of the Bureau. In compliance with executive orders, the mailing lists of all regular publications have been thoroughly purged and revised.

OBSERVATORY BUILDINGS.

The observatory buildings reported in my last report as being in course of construction at Anniston, Ala., Birmingham, Ala., Charles City, Iowa, Iola, Kans., La Crosse, Wis., and Sheridan, Wyo., have been completed and are now in use.

An appropriation of $75,000 has been made for the rebuilding of the main observatory building and for the erection of a central heating and power station at Mount Weather, Va. It is the intention to make these buildings as near fireproof as practicable. As heat and power for all the principal buildings will be supplied from a central station, the danger from fire will be reduced to a minimum.

The building for the central heating and power station has been completed, and an effort will be made to install the boilers and apparatus therein, so that the station may be put into operation by December 15, 1908.

Congress made an appropriation of $15,000 for the completion of the physical laboratory building and the office and cottage building at Mount Weather, work on these structures having been suspended, as stated in my last report, by reason of a decision by the Comptroller. Work on these buildings was begun promptly on July 1, 1908, and the cottage and office building was completed and occupied September 1, 1908. It is expected that the physical laboratory building will be completed by February 1, 1909.

The appropriation bill for the fiscal year beginning July 1, 1908, also provides for the erection of seven new observatory buildings outside of Washington, D. C. These buildings will be located at Abilene, Tex., Dodge City, Kans., Fort Wayne, Ind., Lansing, Mich., Northfield, Vt., Richmond, Va., and St. Joseph, Mo., and sites have been selected except at Fort Wayne and at Richmond. It is expected that these buildings will be completed and ready for occupancy on July 1, 1909.

The following table shows where the Weather Bureau buildings are located, and gives the cost of the buildings and grounds:

Buildings owned by the Weather Bureau.

Location.	Cost of ground.	Cost of buildings.	Total cost.
Amarillo, Tex	$1,255.00	$6,503.00	$7,758.00
Anniston, Ala	1,799.75	12,920.69	14,720.44
Atlantic City, N. J	(a)	5,991.00	5,991.00
Bentonville, Ark	500.00	5,119.90	5,619.90
Birmingham, Ala	[b] 61.50	15,630.36	15,691.86
Bismarck, N. Dak	(a)	10,085.99	10,085.99
Block Island, R. I	1,034.50	7,668.25	8,702.75
Burlington, Vt	[b] 20.00	10,043.50	10,063.50
Cape Henry, Va	(a)	9,222.45	9,222.45
Charles City, Iowa	3,036.75	9,338.47	12,375.22
Columbia, S. C	3,799.00	9,165.00	12,964.00
Devils Lake, N. Dak	2,209.05	7,431.50	9,640.55
Duluth, Minn	2,041.70	7,430.68	9,472.38
Hatteras, N. C	[a][e] 217.00	4,889.75	5,106.75
Havre, Mont	1,795.00	5,087.08	6,882.08
Iola, Kans	2,241.25	9,730.94	11,972.19
Jupiter, Fla	(a)	6,346.90	6,346.90
Key West, Fla	2,020.00	7,994.75	10,014.75
Kittyhawk, N. C	(a)	1,616.00	1,616.00
La Crosse, Wis	3,523.50	12,276.24	15,799.74
Modena, Utah	(a)	4,346.00	4,346.00
Mount Weather, Va.:			
Administration building (including tower and tank)	1,863.15	20,971.12	22,834.27
Power house and balloon building	650.00	8,167.00	8,817.00
Absolute building	(a)	7,000.00	7,000.00
Variation building	(a)	8,904.55	8,904.55
Stable	(a)	1,900.00	1,900.00
Barn	(a)	900.00	900.00
Cottage for workmen	(a)	1,300.00	1,300.00
Physical laboratory	(a)	27,083.89	27,083.89
Cottage and office	(a)	6,800.00	6,800.00
Mount Washington, N. H	(c)	300.00	300.00
Nantucket, Mass	(d)	4,728.53	4,728.53
Narragansett Pier, R. I	4,151.75	8,036.50	12,188.25
North Head, Wash	(a)	3,820.13	3,820.13
North Platte, Nebr	(d)	3,818.50	3,818.50
Oklahoma, Okla	[b] 38.90	10,520.25	10,559.15
Peoria, Ill	[b] 54.00	7,875.50	7,929.50
Point Reyes Light, Cal	(a)	2,875.00	2,875.00
Port Crescent, Wash	102.00	730.94	832.94
Sand Key, Fla	(a)	5,593.00	5,593.00
Sault Sainte Marie, Mich	(a)	2,994.12	2,994.12
Sheridan, Wyo	2,021.75	12,089.30	14,111.05
Southeast Farallon, Cal	(a)	5,211.22	5,211.22
Springfield, Ill	(a)	10,236.50	10,236.50
Tatoosh Island, Wash	(a)	5,000.00	5,000.00
Washington, D. C	(d)	174,950.79	174,950.79
Yellowstone Park, Wyo	(a)	11,156.00	11,156.00
Yuma, Ariz	(a)	1,500.00	1,500.00
Total	34,435.55	523,301.29	557,736.84

[a] Government reservation.

[b] Donated; figures represent cost of title transfer.

[c] Leased.

[d] Building and ground purchased as a whole.

[e] Additional ground purchased.

Buildings rented by the Weather Bureau for living and observatory purposes.

Station.	Annual rent.	Other items included.
Alpena, Mich	$650	Heat, light, water.
Brawley, Cal	300	
Del Rio, Tex	444	Do.
Durango, Colo	440	Do.
East Clallam, Wash	120	Water.
Flagstaff, Ariz	300	
Helena, Mont	504	Steam heating plant, water
Honolulu, Hawaii	1,020	Six rooms; heat, cleaner, light, janitor and porter service, electric current for fan, storage.
Independence, Cal	360	Water
Kalispel, Mont	360	
Lewiston, Idaho	540	
Manteo, N. C	144	
Moorhead, Minn	600	Heat, light, water.
Mount Tamalpais, Cal	420	Heat, light water, free transportation of Government employees and supplies.
Pysht, Wash	144	Water.
Roseburg, Oreg	550	Heat, light, water.
Roswell, N. Mex	720	Heat, cleaner, water
San Juan, P. R	684	Four rooms; light, water.
Thomasville, Ga	420	
Tonopah, Nev	1,200	
Twin, Wash	108	Water.
Williston, N. Dak	510	Heat, cleaner, light, water.
Winnemucca, Nev	360	Heat, light, water.
Total	11,338	

CHANGES IN THE FORCE OF THE BUREAU.

CLASSIFIED SERVICE.

Appointments:	
Probationary—	
Observer, at $1,200	1
Printer, at $1,200	1
Printers, at $1,000	5
Assistant observers, at $720	20
Repairmen, at $720	2
Watchman, at $720	1
Folder and feeder, at $720	1
Folders and feeders, at $630	3
Skilled laborers, at $600	2
Messenger, at $480	1
Messenger boy, at $480	1
Messenger boys, at $450	4
Messenger boys, at $360	60
	102
Transfer—	
Assistant observer, at $1,000	1
Reinstatement—	
Assistant observer, at $1,000	1
Repairman, at $840	1
Assistant observers, at $720	3
Messenger boy, at $480	1
	6
Temporary—	
Compositors, at $1,250	3
Copyists, at $840	4
Repairmen, at $720	2
Watchman, at $720	1
Skilled laborer, at $660	1

Changes in the force of the Bureau—Continued.

CLASSIFIED SERVICE—continued.

Appointments—Continued.	
Temporary—Continued.	
Folders and feeders, at $630	4
Messenger, at $480	1
Messenger boy, at $480	1
Messenger boys, at $360	32
	49
Emergency—	
Clerk, at $1,400	1
Folder and feeder, at $630	1
Skilled laborer, at $600	1
	3
Promotions (all promotions were to the next higher grade or by certification for advancement from subclerical positions)	115
Reductions:	
Causes—	
Inability to perform satisfactorily work to which assigned	3
To grant assignment to preferred station	2
To grant assignment to preferred work	1
Neglect of duty	2
Decreased efficiency due to increasing age and ill health	1
Maintaining disrespectful attitude toward official superior	1
As an offset to the Bureau for allowances of quarters, fuel, and light	1
Necessitated by employees' return to duty from leave of absence without pay	5
Because of being permitted to receive compensation regularly from a State	1
To equalize salaries	1
	18
Resignations:	
Voluntary	68
Required because of—	
Unsatisfactory services	3
Unsatisfactory services and conduct	2
	73
Transferred to the office of the Secretary of Agriculture	1
Removals:	
Causes—	
Misconduct and neglect of duty	1
Absence without authority	1
Absence without authority, and insubordination	2
Defrauding the Government by false vouchers and forgery	1
	5
Dropped from the rolls at termination of probationary period because of unsatisfactory services	2
Deaths	10

Changes in the force of the Bureau—Continued.

UNCLASSIFIED SERVICE.

Appointments:	
Permanent—	
Unskilled laborers, at $450	2
Student assistants, at $300	2
Unclassified laborer, at $240	1
	5
Temporary—	
Unskilled laborer, at $660	1
Unskilled laborer, at $450	1
Student assistant, at $300	1
Charwoman, at $240	1
	4
Promotions (each to next higher grade)	3
Resignations:	
Voluntary	1
Removals:	
Causes—	
Unsatisfactory services	1
Unsatisfactory conduct and services	1
Unsatisfactory conduct and failure to reply to an official communication	1
	3

ABSENCE.

Average number of days, with pay, per employee, during calendar year 1907.

	Sickness.	Annual leave.
Station:		
(99 per cent males)	1.6	6.3
Washington, D. C.:		
Males	5.1	26.4
Females	4.9	28.7
Entire service	2.5	11.4

STATISTICS OF THE SERVICE.

The following tables show the numerical strength of the Bureau and the highest, lowest, and average salaries paid in the commissioned grades:

Numerical strength of the Weather Bureau June 30, 1908.

At Washington, D. C.:		
Classified	179	
Unclassified	11	
		190
Outside of Washington, D. C.:		
Classified	520	
Unclassified	14	
		534
Total commissioned employees		724
Additional employees outside of Washington, D. C.:		
Storm warning display men	181	
River observers	381	
Cotton region observers	143	
Corn and wheat region observers	137	
Rainfall observers	88	
Sugar and rice region observers	9	

Additional employees outside of Washington, D. C.—Continued.		
Special meteorological observers	9	
Cranberry observers	2	
Total noncommissioned employees		950
Total paid employees		[a] 1, 674
Persons serving without compensation (except through the distribution of Government publications):		
Cooperative observers and correspondents (omitting 87 paid and 4 cooperative river and rainfall observers enumerated elsewhere)	5, 734	
Cooperative storm warning display men	74	
Cooperative river observers	16	
Cooperative rainfall observers	10	
Total cooperatives		5, 834
Total numerical strength		7, 508

Distribution of the commissioned force June 30, 1908.

In Washington, D. C.:	
Accounts Division	[b] 13
Climatological Division	7
Editor Monthly Weather Review	[c] 3
Executive branch	[d] 18
Forecast Division	[e] 10
Instrument Division	10
Library	[c] 5
Marine Division	14
Division of Meteorological Records	16
Publications Division	43
River and Flood Service	[e] 2
Supplies Division	9
Telegraph Division	11
Miscellaneous mechanical work (under direction of the chief clerk)	5
Captain of the watch (under direction of the chief clerk)	6
General messenger and laborer service (under direction of the chief clerk)	18
Total	190
Outside of Washington, D. C.:	
56 stations with 1 commissioned employee	56
57 stations with 2 commissioned employees	114
35 stations with 3 commissioned employees	105
20 stations with 4 commissioned employees	80
10 stations with 5 commissioned employees	50
8 stations with 6 commissioned employees	48
2 stations with 7 commissioned employees	14
3 stations with 8 commissioned employees	24
2 stations with 9 commissioned employees	18
2 stations with 10 commissioned employees	20
1 station with 15 commissioned employees	15
196 stations	[f] 544

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[a] This total embraces all paid persons connected with the Bureau on June 30, 1908, except 8 snow and ice reporters who report under certain conditions during the occurrence of snow and ice, and 16 commissioned employees absent on that date and who had been granted leaves of absence or furloughs without pay for one month or more.

[b] One employee devotes a portion of his time at one of the map stations at the United States Capitol.

[c] One employee temporarily assigned.

[d] Two employees temporarily assigned and another devotes a portion of his time at one of the map stations at the United States Capitol.

[e] The River and Flood Service, including two of the commissioned force, heretofore assigned as part of the Forecast Division.

[f] This number represents the normal station force. On June 30, 1908, there were actually on regular duty but 534 employees.

In addition to the foregoing there are eight special observing (one-man) stations in the West Indies, mainly in operation during the hurricane season, and a special repair station in Washington, operated from October to April, inclusive.

The following salary table omits persons on duty at special observing and substations where the salaries are $25 a month or less, and where, as a rule, the tour of duty covers but a small fraction of the day and only certain seasons of the year:

Salaries paid in the commissioned grades.

Grades.	June 30, 1908.	
	Station.	Washington, D. C.
Classified grades:		
Highest salary	$3,000	$5,000
Lowest salary	360	450
Average salary	995	1,189
Unclassified grades:		
Highest salary	600	720
Lowest salary	240	240
Average salary	343	469

Average salary of all (station and Washington) is $1,022.

REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., October 31, 1908.

Sir: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1908, together with plans and recommendations for the future.

Respectfully,

A. D. Melvin,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

LINES OF WORK.

The work of the Bureau in the interest of the live-stock industry and the public health has continued as heretofore along the following principal lines, all of which are more or less intimately connected:

Meat inspection.
Inspection of animals for export and of vessels carrying them.
Supervision of the interstate transportation of live stock.
Inspection and quarantine of imported animals.
Eradication of the diseases known as "scabies" of sheep and cattle.
Eradication of southern cattle ticks.
Inspection of southern cattle.
Scientific investigations concerning diseases of animals.
Work in animal husbandry.
Work in the interest of the dairy industry and of wholesome dairy products.

The force of employees has remained practically stationary in number, there being 3,136 on the rolls July 1, 1908, as compared with 3,152 a year before. Of the former number, 2,203 were engaged in meat inspection.

A few of the more important matters with which the Bureau is concerned will be discussed briefly, after which the work of the various divisions will be presented more in detail.

THE MEAT INSPECTION.

The Federal meat inspection has been extended during the year, and it is estimated that it now covers slightly more than one-half of the entire number of animals slaughtered for food in the United States. Details of the year's operations will be found in the portion of this report which deals with the Inspection Division. With two years' experience under the new law the work is better systematized and more uniformly carried on at the various stations. The large force engaged in this service maintains a high standard of efficiency, and every effort is made to insure the wholesomeness of the inspected product, sanitary conditions of preparation, and honesty of labeling. The new regulations are based on the best and most recent scientific knowledge and judgment, and it is safe to say that no country has a more stringent meat-inspection system or one which better safeguards the health of the consumer of meat products.

One effect of the inspection under the new law has been a marked improvement in the sanitary condition of the abattoirs. In old establishments there have been many improvements, and in the construction of new buildings such materials have been used as would promote sanitation.

Newspaper reports of the finding of preservatives in American meat products abroad make a statement of the facts desirable. The meat-inspection law, after prohibiting the use of dyes, chemicals, preservatives, or ingredients which render the meat or meat food product unsound, unhealthful, unwholesome, or unfit for human food, makes the following exception:

> *Provided*, That, subject to the rules and regulations of the Secretary of Agriculture, the provisions hereof in regard to preservatives shall not apply to meat food products for export to any foreign country and which are prepared or packed according to the specifications or directions of the foreign purchaser, when no substance is used in the preparation or packing thereof in conflict with the laws of the foreign country to which said article is to be exported.

The use of preservatives in inspected meat is not permitted except in strict accordance with the foregoing provision of law. However, when foreign purchasers specify that preservatives shall be used, and when foreign governments do not prohibit the importation of meat food products prepared with preservatives, it seems very inconsistent that complaint should be made when preservatives are found. In some instances, however, when the presence of preservatives has been reported and when investigation has shown that no preservative was really added, it has been determined that the alleged preservative was a natural constituent of normal meat and that the amount found was only the merest trace and no more than frequently occurs naturally.

While the Federal inspection is limited to establishments or persons doing an interstate or export business, the Bureau has opportunities for learning conditions at other places. It should be borne in mind that nearly half of the meat supply of the country does not come under Federal inspection and that only a very small part of this receives an efficient State or municipal inspection. Some of the most insanitary and revolting conditions have been found at small local abattoirs, which are not and can not be reached by the Federal inspection. It is only natural, too, that suspicious and diseased live stock, which might be condemned if sent to an inspected establishment, finds its way to the uninspected places; and as the Federal law prohibits the interstate shipment of uninspected meat, it follows that the product of the numerous abattoirs which are without Federal inspection is sold and consumed within the States where they are located. Furthermore, this Bureau frequently finds preservatives in meats prepared by local butchers.

There is great need, therefore, for the States and cities to provide an adequate local inspection which will protect their people against these local establishments. Few States have done anything in that direction, and very few cities have an adequate and efficient inspection. In most cities where there is a municipal inspection it consists simply in an examination of the meat as exposed for sale in the markets and stores. Such an inspection is almost worthless. While it may result in the condemnation of a certain amount of unwholesome and tainted meat, the average purchaser is able to detect and avoid such meat for himself. What is required is an inspection that will protect the consumers where they can not protect themselves, namely, by guarding against the meat of diseased animals. This can be done only by having a sufficient number of competent veterinarians to inspect the carcasses at the time of slaughter, and this is a kind of inspection that very few cities have. Without such a local inspection the consumer can be assured of wholesome meat only by purchasing no meat except that bearing the Government inspection label.

PROGRESS IN SUPPRESSING DISEASES OF LIVE STOCK.

Gratifying headway has been made in the work of controlling and eradicating contagious diseases of live stock. Especially is this true with regard to sheep scab. During the fiscal year the quarantine on account of this disease was removed from two States (Idaho and Wyoming), and since the close of that period it has been removed from Kansas, Nebraska, and large parts of North Dakota and South Dakota. In the 12 States and Territories remaining in quarantine such good progress has been made that the amount of infection remaining is very small in all but California. The situation is so encouraging as to lead to the hope that considerable additional territory can be released during the coming year, and that the disease may be entirely wiped out within a few years.

The quarantine on account of cattle mange was removed during the fiscal year from parts of Kansas and Nebraska, and has since been removed from parts of North Dakota, Colorado, Kansas, Oklahoma, and New Mexico. Parts of 10 States and Territories still remain in quarantine.

The work of exterminating the ticks which are such a detriment to the cattle industry of the South has been continued vigorously and with good results. During less than three years of this work nearly 64,000 square miles of territory have been freed from these troublesome parasites. This is an area somewhat larger than that of the State of Georgia. This gives assurance of ultimate success, although many years will probably be required for the completion of the work. Much depends upon the amounts appropriated for this work by the States, as well as by the Federal Government, but more upon the assistance and cooperation of the cattle owners themselves, for without a fair degree of cooperation the eradication of the tick can never be accomplished.

HOG CHOLERA VACCINE.

The vaccine or serum for the prevention of hog cholera, prepared according to methods worked out under the direction of Dr. M. Dorset, chief of the Biochemic Division, as described in previous reports, has been further tested in a practical way during the year and its efficacy has been still further confirmed.

In order to make this treatment available for general use it is necessary that some arrangements should be made for supplying the vaccine to hog raisers. To prepare vaccine for the entire country, however, would be such a great undertaking that the Bureau does not feel warranted in attempting it. It is believed that the best way of accomplishing this object would be for the various States to prepare the serum and furnish it to citizens on such terms as may be thought proper. With this object in view the Department invited a number of experiment station and State veterinarians to visit the Bureau's experimental farm near Ames, Iowa, so as to observe the method of preparing and applying the vaccine. At these conferences the opinion was generally expressed that the vaccine can be successfully used in the prevention and control of hog cholera, also that it was advisable for the States to make ample provisions for this very important work. In most States separate appropriation should be made for providing suitable laboratories and farms where the serum can be prepared by competent assistants under the supervision of the live-stock sanitary board or State veterinarian. Some of the State experiment stations have successfully undertaken to prepare and distribute the vaccine, and it is hoped that others will do likewise.

THE TUBERCULOSIS PROBLEM.

The most serious problem now confronting the live-stock industry is tuberculosis. This disease has progressed to an alarming extent and is undoubtedly on the increase, especially in States where no adequate measures have been taken against it. The recent agitation in favor of a more wholesome food supply has drawn attention to tuberculosis not only as it relates to the health of the consumer of meat and dairy products, but as it affects the business of raising live stock in an economic way. Judging from the meat-inspection statistics and from records of the tuberculin test, it is estimated that more than 1 per cent of the beef cattle, 10 per cent of the dairy cattle, and 2 per cent of the hogs in the United States are affected with tuberculosis. The financial loss that is chargeable to this disease among farm animals amounts to no less than $14,000,000 annually. Both in the interest of the public health and for the financial benefit of stock raisers, it is time that more aggressive and systematic measures were taken to suppress and eradicate this disease.

During the past year the Bureau has been endeavoring, in cooperation with the authorities of Nebraska and Wisconsin, to trace the origin of animals found affected with tuberculosis in the meat inspection. The results of this work have been very satisfactory in the way of enabling the State authorities to locate and stamp out centers of infection. In Nebraska, for instance, in every case where diseased animals have been found in the meat inspection and their origin traced back to the farm, tuberculosis has been found among the live stock remaining on the farm. It is therefore evident that the meat inspection can be made an effective agency for discovering and locating the presence of disease, and it seems important that the meat inspection should continue to be intimately connected with the administration of any work for the eradication of tuberculosis as well as other contagious diseases of live stock.

In order to give general application to this plan of tracing the disease, it seems essential that the various States should empower their officials by law to require that shippers shall tag their live stock, especially cows, shipped for slaughter, in such a way that they may be identified and their origin determined.

The agricultural appropriation act for the fiscal year 1909 authorizes the Secretary of Agriculture "to investigate the prevalence and extent of tuberculosis among dairy cattle in the United States," and under this authority steps are being taken to collect such information. This should be followed, however, by systematic work on a large scale by the Federal and State authorities in cooperation, with a view to the ultimate eradication of tuberculosis from farm animals. This work to be successful will require many years and considerable expenditures, but there is no doubt that such expenditures will be a profitable investment, even if the subject is considered wholly from the financial standpoint. After more specific information is obtained as to the extent of the infection and as to the localities in which it prevails, the tuberculin test should be applied generally and systematically in the infected sections, this test being unquestionably the most accurate method of diagnosis known. The safest way of disposing of diseased animals is to slaughter them, but in order to make the financial loss as light as possible it would be well to have such animals slaughtered at abattoirs having Federal or other competent veterinary inspection. In this way a large proportion may be safely passed for food and made to yield their full meat value, while only those whose meat may be dangerous to health will be condemned. It seems only reasonable that persons whose animals are condemned and slaughtered should be paid indemnity, at least in part.

An important step looking toward the suppression of tuberculosis in live stock was taken in the organization in New York City in March of an association of live-stock sanitary officers of the States of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, and New Jersey, with the special object of regulating and controlling the movement between those States of dairy and breeding cattle.

INADEQUACY OF STATE LAWS FOR DEALING WITH CONTAGIOUS DISEASES OF ANIMALS.

Much of the Bureau's work for the control and eradication of contagious disease of live stock has been done in cooperation with State officers. In a few States the authorities are provided with both laws and funds for such work, but in a large majority of the States this is not the case. The Bureau has recently collected the laws of various States bearing on this subject, and it is found that in most of the States the laws are very inadequate for the protection of live stock against contagious diseases and that in most cases the appropriations are entirely insufficient for effective work. While many of the States have cooperated very effectively with the Federal Government in the eradication of sheep scabies, cattle mange, and the southern cattle tick, the lack of ability on the part of other States to do their share in such work has resulted in delaying its progress. It is very important for the success of such work, especially with regard to the cattle tick and tuberculosis, that the States concerned should enact laws giving adequate powers to their officers and should make sufficient appropriations for the work that is to be done. In work of this kind it seems reasonable and proper that the expense should be divided equally between the States and the General Government.

RANGE CONDITIONS IN THE WEST.

Much of the Bureau's field work is done in the range country of the West, and good opportunities are afforded for studying conditions in that section as they affect the live-stock industry. The conditions on the open range are unsatisfactory from the standpoint of both the stock owners, who desire to use it for grazing purposes, and the sanitary officers, who are combating contagious diseases of live stock. It is well known that, aside from the reduction of the area of public range as a result of the taking up of homesteads, the grass on the remaining range has been so depleted that the number of animals which can be supported on a given area is much less than formerly. This condition is due to overstocking and misuse of the range. The range has been overcrowded, especially at certain seasons and in the vicinity of watering places, and the close grazing and tramping have in some places almost exterminated the native grass. It has also been found very difficult to eradicate or even to prevent the spread of contagious diseases of live stock on the open range, because the lack of fences or inclosures makes it practically impossible to control the movement of animals. This is especially true in the case of cattle mange, and if some more destructive disease should gain a foothold under such conditions it would undoubtedly cause enormous loss.

The best remedy for both of these conditions, in my opinion, would be the passage by Congress of a law regulating grazing and providing for the leasing of public range. By this means the range would be brought under definite proprietorship, and the lessees could exercise control over the land and would be encouraged to make improvements which would aid in conserving both the live stock and the range. Under such circumstances the enforcement of quarantine measures would be much easier.

ADDITIONAL AUTHORITY NEEDED FOR DEALING WITH CONTAGIOUS DISEASES.

Under existing legislation the Secretary of Agriculture has power to enforce measures for the protection of the live stock of the United States against the introduction of contagious diseases from abroad so far as they are liable to be brought in with imported animals or with hay, straw, forage, or similar material, or meats, hides, or other animal products from infected countries. There still remains, however, the danger that the contagion of some destructive animal disease may be introduced by the importation of virus or cultures of organisms causing such diseases. It is therefore respectfully recommended that

Congress enact a law prohibiting the importation, except with permission of the Secretary of Agriculture, of any virus that may be infectious for domestic animals. It is not the intention to prevent absolutely the importation of virus and cultures from abroad or to interfere with any proper scientific investigations by responsible persons, but it is considered desirable to have all such importations subject to the control and approval of the Secretary of Agriculture in order to avoid the introduction and spread of contagious diseases by careless investigators.

Authority should also be given to build fences along the international boundary lines, in order to control the movement of live stock and prevent the introduction of contagion.

As further measures to prevent the spread of contagious diseases of animals, the Secretary of Agriculture should have power to require the cleaning and disinfection of cars carrying interstate shipments of live stock, at such times and places as he may deem necessary; also to require that stockyards handling live stock which is the subject of interstate transportation shall be equipped and maintained in such manner as he may consider necessary in order to facilitate disinfection.

MORE LAND NEEDED FOR EXPERIMENT STATION.

The Bureau Experiment Station at Bethesda, Md., greatly needs more land in order to carry on properly experimental work with animal diseases and in breeding small animals, feeding poultry, etc. A tract of about 60 acres adjoining the land owned by the station has been leased so as to obtain more ground, but this arrangement is unsatisfactory, as the termination of the lease by the owners would cause serious injury to work under way, and might even force the abandonment of unfinished investigations. It is highly desirable that the station should be provided with sufficient land owned by the Government, and I respectfully recommend that Congress be asked to appropriate the necessary sum for the purchase of acreage at least equal to that now leased.

PUBLICATIONS.

There has been an unusual demand for the publications of the Bureau, especially those relating to tuberculosis and sanitary milk production. During the fiscal year there were issued by the Bureau 79 new publications, aggregating 2,446 printed pages, and besides these there were numerous reprints of former publications. The new publications consisted of the Twenty-third Annual Report of the Bureau (for 1906), a revised edition of the Special Report on Diseases of the Horse, the annual report of the Chief of the Bureau for the previous fiscal year, 9 bulletins, 23 circulars, 25 orders and regulations, 2 Yearbook articles, and 17 miscellaneous publications. The Special Report on Diseases of the Horse has proved to be one of the most popular publications ever issued by the Government, the total number of copies printed up to date amounting to almost 1,000,000. A monthly publication, issued under the name of "Service Announcements," has been found exceedingly useful in disseminating information and instructions to the large force of employees, especially in the meat-inspection service. In addition to the publications issued during the fiscal year, the Twenty-fourth Annual Report of the Bureau (for 1907) was prepared for publication. These annual reports are volumes of several hundred pages, and contain special articles of both a popular and a scientific nature, in addition to miscellaneous information relating to the live-stock industry and the work of the Bureau.

THE INSPECTION DIVISION.

The work of the Inspection Division, in charge of Dr. R. P. Steddom, chief, consists, as heretofore, of two main lines: (1) the meat inspection and (2) most of the field work for the control and eradication of contagious diseases of animals. The latter comprises the inspection of southern cattle and the supervision of their movement when forwarded from the area quarantined on account of Texas or tick fever, the work for the extermination of the southern cattle tick which spreads this disease, and the work for the eradication of scabies of sheep and cattle in the West.

THE MEAT INSPECTION.

In the report for the fiscal year 1907 some of the tabular information covered only the nine months in which the new law had been in operation, while by consolidating the figures representing the work done under the old and new laws some tables were made to cover the entire year. The present report, therefore, is the first to cover an entire fiscal year's operations under the meat-inspection law of June 30, 1906, which became effective October 1, 1906.

NEW REGULATIONS.

The meat-inspection regulations promulgated July 25, 1906, and issued as B. A. I. Order 137, and the ten amendments thereto, were revised and republished as B. A. I. Order 150, effective April 1, 1908. The regulations are based upon the experience of more than a year and a half under the operation of the new law, and not only embody the judgment of the experts of the Department of Agriculture, but in their preparation the recommendations of a committee of outside scientists appointed by the Secretary have been adopted to a great extent. The more important features of the revised regulations are those—

(*a*) Imposing inspection upon branch houses of establishments having inspection if such branch houses engage in interstate or foreign commerce and slaughter animals or "process" meat.

(*b*) Prescribing the domestic meat label to be furnished by the establishment for use on interstate shipments of meat or meat food products in lieu of the regular white meat-inspection stamp previously furnished by the Bureau.

(*c*) Requiring the separation on or before October 1, 1908, of compartments in which edible products are prepared or handled from those in which inedible products are prepared or handled for industrial uses.

(*d*) Authorizing inspectors in charge to permit the return to official establishments, subject to reinspection, of inspected and passed products which are alleged to have become unsound.

ESTABLISHMENTS AND CITIES.

The records show that during the year inspection has been conducted at 787 establishments in 211 cities and towns, a gain of 79 establishments and 25 cities and towns as compared with the previous fiscal year. Inspection was withdrawn during the year from 95 establishments. Of this number 77 either discontinued slaughtering or so altered their business that Federal inspection was not required, 1 manufactures products for medical use only, 1 manufactures only inedible fats, 2 were given market inspection, 2 transferred their business to other establishments, 3 violated the regulations by adulterating lard with tallow and low-grade fat, 1 was given exemption, 3 failed financially, 4 were insanitary, and 1 displayed a misleading sign.

Below are shown the number of establishments and the number of cities and towns where inspection of meat and meat food products was conducted in each fiscal year since 1891.

Number of establishments and cities where meat inspection has been conducted, fiscal years 1891 to 1908.

Year.	Establishments.	Cities and towns.	Year.	Establishments.	Cities and towns.
1891	9	6	1900	149	46
1892	23	12	1901	157	52
1893	37	16	1902	155	50
1894	46	17	1903	156	50
1895	55	19	1904	152	51
1896	102	26	1905	151	52
1897	128	33	1906	163	58
1898	135	35	1907	708	186
1899	139	42	1908	787	211

MARKET INSPECTION.

During the fiscal year market inspection has been granted to 4 more cities, thus making 33 cities that now have the privilege of forwarding from public markets, upon reinspection and under marks of Federal inspection, interstate shipments of inspected and passed meat or meat food product which, in being prepared for delivery to the customer, becomes separated from the original mark of Federal inspection.

EXEMPTION FROM INSPECTION.

During the year about 116,000 shipments were made under certificates of exemption as provided by law. The total weight of these shipments can not be determined, as in many instances the weight has not been included in the shipper's certificate. However, a determined effort is now being made to have the weight of every shipment reported, so that hereafter an accurate record of this traffic may be kept.

The number of certificates of exemption outstanding June 30, 1908, was 2,477, as against about 4,000 at the end of the previous fiscal year. In accounting for the reduced number it may be said that in some instances exemption has been superseded by inspection, while in others the certificates have been recalled on account of poor sanitation, violation of the regulations, etc.; however, the great majority of previous holders of certificates are permitted under the law to ship as farmers, and hence need no certificate of exemption. Certificates are required for retail butchers and retail dealers.

ANTE-MORTEM INSPECTION.

The number of ante-mortem inspections made of animals for slaughter is shown in the following table, and indicates an increase of 6 per cent over the previous fiscal year.

Ante-mortem inspections of animals about to be slaughtered, fiscal year 1908.

Kind of animals.	Passed.	Suspected.[a]	Total.
Cattle	7,198,224	32,048	7,230,272
Calves	1,993,461	2,134	1,995,595
Sheep	9,778,189	1,751	9,779,940
Swine	34,980,571	27,456	35,008,027
Goats	46,066	1	46,067
Total	53,996,511	63,390	54,059,901

[a] This term is used to designate animals found diseased or suspected of being unfit for food on ante-mortem inspection, most of which are afterwards slaughtered under special supervision, the final disposition being determined on post-mortem inspection.

POST-MORTEM INSPECTION.

The following table shows the number of inspections made at time of slaughter, an increase of 5.96 per cent over the previous fiscal year:

Post-mortem inspections, fiscal year 1908.

Kind of animals.	Passed for food.	Passed for lard and tallow only.	Condemned.	Total.
Cattle	7,081,315	1,744	33,216	7,116,275
Calves	1,989,629	4	5,854	1,995,487
Sheep	9,694,359	96	8,090	9,702,545
Swine	34,878,469	106,675	127,933	35,113,077
Goats	45,920	....	33	45,953
Total	53,689,692	108,519	175,126	53,973,337

Included in the foregoing table are the post-mortem inspections of animals rejected or suspected on ante-mortem inspection, and the final inspection of carcasses that were retained[a] for disease or other cause at time of slaughter.

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[a] This term is applied to carcasses held on suspicion on first post-mortem examination, to be subjected later to more thorough examination for determining final disposition.

The various diseases and conditions for which fresh carcasses and parts were condemned and tanked are shown in the following table:

Diseases and conditions for which condemnations were made on post-mortem inspection, fiscal year 1908.

Cause of condemnation.	Cattle.		Calves.		Sheep.		Swine.		Goats.	
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.
Tuberculosis	24,371	27,467	159	91	8	1	77,584	628,462	......	......
Actinomycosis	667	32,430	3	26	......	......	......	......	......	......
Hog cholera and swine plague	......	......	......	......	......	......	27,234	......	......	......
Septicemia, pyemia, and uremia	1,015	......	302	......	588	......	7,076	......	3	......
Pneumonia, pleurisy, enteritis, hepatitis, nephritis, metritis, etc	1,506	......	267	......	1,100	......	6,846	......	1	......
Icterus	125	......	183	......	869	......	1,784	......	9	......
Texas fever	373	......	663	......	......	......	......	......	......	......
Caseous lymphadenitis	......	......	......	......	1,034	2	......	......	5	......
Tumors and abscesses	116	4,357	46	18	105	27	1,280	1,544	......	......
Pregnancy and recent parturition	208	......	......	......	100	......	235	......	......	......
Injuries, bruises, etc	1,856	1,891	315	217	647	138	354	3,332	3	1
Immaturity	......	......	3,097	......	......	......	......	......	......	......
Sexual odor	......	......	......	......	......	......	1,186	......	......	......
Miscellaneous	2,979	1,337	819	44	3,639	30	4,354	3,251	12	......
Total	33,216	67,482	5,854	396	8,090	198	127,933	636,589	33	1

SUPERVISING PREPARATION OF MEATS AND PRODUCTS.

The amount of meat food product prepared and processed under Bureau supervision is shown in the following table:

Meat and meat food products prepared and "processed" under Bureau supervision, fiscal year 1908.

Kind of product.	Weight.	Kind of product.	Weight.
	Pounds.		*Pounds.*
Beef placed in cure	177,555,376	Lard substitute	408,666,880
Pork placed in cure	2,875,997,349	Oleo stock and edible tallow	56,136,236
All other classes placed in cure	6,260,940	Oleo oil	163,289,340
Sausage chopped	416,199,855	Lard stearin	11,805,632
Canned beef	62,396,382	Oleostearin	73,999,893
Canned pork	27,392,485	Oleomargarin and butterine	79,380,283
All other canned meats	2,792,935	Miscellaneous products	134,150,192
Beef extract	715,829		
Lard	1,433,777,993	Total	5,958,298,364
Lard compound	27,780,764		

The following amounts of meat and meat food products were condemned on reinspection during the fiscal year: Beef, 31,653,279 pounds; pork, 11,504,400 pounds; mutton, 128,230 pounds; veal, 58,239 pounds; goat meat, 58 pounds; total, 43,344,206 pounds. The principal causes for condemnation were that the meat or product was found to be sour, tainted, putrid, unclean, or, in the case of fats, rancid. The foregoing figures show an average monthly increase over the condemnations on reinspection during the first nine months under the new law of about 118 per cent.

INTERCHANGE OF MEATS BETWEEN OFFICIAL ESTABLISHMENTS.

During the year the following amounts of inspected and passed meat and meat food products were, upon identification as " U. S. inspected and passed " by Bureau employees, admitted to official establishments: Beef, 794,496,355 pounds; veal, 23,055,853 pounds; mutton, 26,204,576 pounds; goat meat, 26,334 pounds; pork, 1,668,782,221 pounds; total, 2,512,565,339 pounds.

MEATS AND PRODUCTS CERTIFIED FOR EXPORT.

The amount of meat and meat food products certified by the Bureau for export shows an increase of 13.8 per cent over the previous fiscal year. The following table shows the classification:

Inspection certificates issued for export of meat and meat food products, fiscal year 1908.

Kind.	Number.	Beef.	Mutton.	Pork.	Total.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Regular	75,983	424,914,258	4,089,021	737,807,291	1,166,810,570
Preservative	46,312	5,852,094	35,460	373,063,684	378,951,238
Total	122,295	430,766,352	4,124,481	1,110,870,975	1,545,761,808

There were also issued 2,626 " animal-product " certificates, covering the exportation of 26,007,484 pounds of such inedible products as hoofs, horns, casings, bladders, bungs, etc.

CONTROL OF CONTAGIOUS DISEASES.

TEXAS FEVER.

The regulations to prevent the spread of splenetic fever in cattle were amended in March, 1908, by amendment 3 to B. A. I. Order 143, effective April 1. In this amendment the specifications for quarantine yards at points outside the quarantined area, and for native yards at points within the quarantined area, were amplified with a view to further eliminating the danger of spreading the Texas fever tick. The live stock inspector detailed to the inspection of the facilities of stock-yard and transportation companies for handling southern cattle at points outside the quarantined area is still pursuing that work, and much has been accomplished in the way of bringing these facilities up to the standard required by the regulations. It is but proper to state that almost without exception the necessary alterations or improvements have been cheerfully made. An effort is also being made to enforce a more strict compliance with the regulations governing the disinfection of infected cars, and to this end transportation companies are being required, whenever practicable, to have this work done at the points of unloading, thus reducing to a minimum the number of infected cars that are permitted to be forwarded for cleaning and disinfection at other points.

The shipments of cattle of the quarantined area to northern markets for immediate slaughter show an increase over the previous quarantine season of 15.65 per cent, the number of head being 1,157,285, contained in 40,262 cars.

There were inspected in the provisionally quarantined area 333,610 head of cattle which were permitted to be shipped to points outside the quarantined area for purposes other than immediate slaughter. These cattle were moved under 3,175 certificates issued by Bureau employees.

During the fiscal year 153,480 head of cattle were dipped in crude petroleum under Bureau supervision, and 39,444 cars that had carried southern cattle were cleaned and disinfected.

THE ERADICATION OF CATTLE TICKS.

The work of eradicating the ticks which spread the contagion of so-called "Texas fever" of cattle has been continued with good effect, in cooperation with the various States interested. As a result of this work a total area of more than 40,000 square miles, as shown by the following table, was released from quarantine during the fiscal year:

Area released from quarantine as a result of tick eradication, fiscal year 1908.

State.	Square miles.	State.	Square miles.
California	21,136	North Carolina	6,312
Texas	660	Virginia	3,181
Oklahoma	2,612		
Arkansas	3,071	Total	40,798
Tennessee	3,826		

In addition to the States represented in the foregoing list, active operations are being carried on in the States of South Carolina, Georgia, Alabama, Mississippi, Louisiana, and Missouri, and some assistance is still being rendered to the authorities in Kentucky.

During the year 2,271,436 inspections of cattle were made, of which 1,372,648 were reinspections.

SCABIES IN SHEEP.

Amendment 1 to B. A. I. Order 146, effective October 15, 1907, released from quarantine on account of scabies in sheep the States of Idaho and Wyoming, and since the close of the fiscal year an order has been issued releasing the States of Kansas and Nebraska and those portions of North Dakota and South Dakota lying east and north of the Missouri River. The whole number of inspections made during the fiscal year was 59,471,141, a decrease, as compared with the previous year, of 5.3 per cent. The whole number of dippings recorded during the fiscal year was 17,589,578, of which 4,881,979 were redippings. The increase in dippings, due to a general dipping in New Mexico during the fall of 1907 and active work in California during the spring and summer of 1908, was 45 per cent as compared with the previous year.

The following table shows the number of inspections and dippings of sheep for scabies and the number of cars cleaned and disinfected on account of this disease since 1900:

Inspections and dippings of sheep for scabies, and cars cleaned and disinfected, fiscal years 1900 to 1908.

Fiscal year.	Inspections.	Dippings.	Cars cleaned and disinfected.
1900	1,801,392	626,838	....
1901	7,912,724	1,034,368	....
1902	11,186,661	1,017,162	791
1903	16,444,370	2,167,002	752
1904	40,967,961	9,578,476	2,732
1905	53,680,786	16,873,659	7,965
1906	59,246,288	12,396,976	8,625
1907	62,625,831	12,133,466	6,275
1908	59,471,141	17,589,578	9,338

SCABIES IN CATTLE.

By amendment 1 to B. A. I. Order 145, effective March 1, 1908, and amendment 2 to the same order, effective May 1, 1908, 4 counties in Kansas and 57 counties in Nebraska were released from quarantine for scabies in cattle, and since the close of the fiscal year an order has been issued releasing the remainder of that portion of North Dakota lying east and north of the Missouri River, and 6 whole counties and portions of 7 other counties in Colorado.

The whole number of inspections made during the fiscal year was 16,920,100, an increase of 11 per cent over the previous year; and the whole number of dippings, 1,527,280—of which 246,278 were redippings—is an increase over the previous year of 227.3 per cent.

The following table shows the inspections and dippings of cattle for scabies, and cars cleaned and disinfected on account of that disease, since 1904:

Inspections and dippings of cattle for scabies, and cars cleaned and disinfected, fiscal years 1904 to 1908.

Fiscal year.	Inspections.	Dippings.	Cars cleaned and disinfected.
1904	1,124,321	162,554	532
1905	14,085,267	563,394	29,897
1906	14,983,260	243,826	19,992
1907	15,243,323	466,623	15,009
1908	16,920,100	1,527,280	17,601

SCABIES IN HORSES.

The whole number of inspections of horses and mules for scabies was 21,727, and the whole number of dippings or sprayings was 5,593.

THE QUARANTINE DIVISION.

The Quarantine Division, under the direction of Dr. R. W. Hickman, chief, has charge of the work of the Bureau relating to the exportation and importation of live stock, including the management of the quarantine stations at various ports of entry for imported animals, and also conducts certain special investigations.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

During the fiscal year 638 inspections of vessels carrying live stock were made before clearance, in order to see that the regulations were complied with as to fittings, equipment, ventilation, feed, water, attendants, etc., and 1,093 certificates of inspection were issued for American cattle. The following table gives statistics of inspection of live animals for export during the year:

Number of inspections of American and Canadian animals for export, number rejected, and number exported, fiscal year 1908.

Kind of animals.	American.			Canadian.		
	Number of inspections.	Number rejected.	Number exported.	Number inspected.	Number rejected.	Number exported.
Cattle	570,527	496	301,209	34,743	19	34,724
Sheep	82,579	12	41,438	30,477	8	30,469
Swine	663	....	663	....	....	....
Goats	79	....	79	....	....	....
Horses	1,109	1	1,332	6	....	6
Mules	591	....	591	....	....	....
Asses	8	....	8	....	....	....
Total	655,556	509	345,320	65,226	27	65,199

Most of the animals included in the foregoing statement were shipped to Great Britain. There went to that country, of the American animals, 293,107 cattle, 40,071 sheep, and 963 horses, and of the Canadian animals 34,045 cattle and 30,079 sheep.

The inspection of vessels carrying export cattle and the enforcement of the regulations referred to continue to result in an exceedingly low percentage of losses of animals in transit. Statistics of animals landed at three principal British ports show that only 0.17 per cent of the cattle, 0.22 per cent of the horses, and 0.95 per cent of the sheep were lost at sea.

During the fiscal year there were inspected for export to Canada 34,835 sheep, 1,779 horses, 487 cattle, and 7 hogs. Of these horses, 1,726 were tested with mallein for glanders, of which number 7 reacted and were excluded from exportation. Of the cattle, 319 were tested with tuberculin, of which number 16 failed to pass. During the fiscal year 226 American horses were reported as inspected and subjected to the mallein test by Canadian official veterinarians at the border, and of this number 89 reacted and were rejected.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

In order to protect the live stock of the United States from contagion that is liable to be introduced with animals from other countries, the regulations require that all horses, cattle, sheep, and other ruminants and swine imported into the United States must be inspected before they are admitted, and, in addition, that all ruminants and swine from any part of the world except North America shall be quarantined. For the importation of animals for which quarantine is required, a permit (in duplicate) must be procured from the Secretary of Agriculture prior to shipment. Importations are not permitted at all from some parts of the world where destructive diseases of animals prevail.

The following tables show the number of imported animals inspected and quarantined and the number inspected but not quarantined during the fiscal year:

Number of imported animals inspected and quarantined, fiscal year 1908.

Ports of entry.	Cattle.	Sheep.	Swine.	Goats.	Other animals.
New York	604	268	42	3	115
Boston	43	7	5	1	....
Baltimore	....	113	....	....	....
Canadian border ports	162	102	29	....	....
Total	809	490	76	4	115

Number of imported animals inspected but not quarantined, fiscal year 1908.

Ports of entry.	Cattle.	Sheep.	Swine.	Horses.	Mules and asses.	Goats.	Other animals.
New York	....	....	....	2,901	168	....	7
Boston	....	2	....	153	1	....	....
Philadelphia	....	....	....	7	....	....	....
Baltimore	....	....	....	104	....	....	....
New Orleans	....	....	....	54	....	....	....
San Francisco	....	....	....	....	1	....	....
Portland, Me	....	....	....	43	....	....	2
Mexican border ports	65,485	41,565	380	1,016	1,205	748	23
Canadian border ports	15,951	115,655	534	3,341	12	5	33
Total	81,436	157,222	914	7,619	1,387	753	65

TUBERCULIN TEST IN GREAT BRITAIN.

The regulations governing the importation of animals subject to inspection and quarantine provide that all cattle six months old or over imported from Great Britain, Ireland, and the Channel Islands shall be tested with tuberculin by an inspector of the Bureau of Animal Industry before being exported or after arrival at the animal quarantine station at the port of entry. The following table shows the results of such tests made in Great Britain during the fiscal year:

Results of tuberculin tests in Great Britain of cattle for importation, fiscal year 1908.

Breed.	Passed.	Rejected.
Shorthorn	1	....
Jersey	357	4
Ayrshire	42	8
Guernsey	144	1
Galloway	11	....
Total	555	13

CONTROL AND TREATMENT OF ANIMAL DISEASES.

To the Quarantine Division there is assigned a large amount of correspondence requesting information and asking for aid in combating animal diseases. Material assistance is rendered to State live-stock sanitary boards and other officials in enabling them to locate and take proper procedure for the control of contagious diseases of animals in their States, and, as far as practicable, cooperative assistance is given to the State officers in the suppression of such outbreaks. Farmers and breeders of animals are advised in the case of noncontagious diseases of the most approved and simple measures for their prevention and cure.

TUBERCULIN TESTING OF CATTLE IN THE DISTRICT OF COLUMBIA AND VICINITY.

The work of applying the tuberculin test to dairy cattle in the District of Columbia and vicinity was started in the spring of 1907, under the direction of the Pathological Division, but was later transferred to the Quarantine Division. The principal object has been to assist the Health Department of the District of Columbia in its efforts to create a milk supply free from the contamination of the germs of tuberculosis. The test is applied without charge and upon the voluntary request of the owner of the cattle, provided that he sign a form of agreement with the Bureau. A steadily increasing number of dairymen have availed themselves of this opportunity of proving the health of their herds or of detecting and removing tuberculous animals. The following public institutions in the District of Columbia, which includes all such institutions maintaining their own herds of dairy cattle, have had the tuberculin test applied to their cattle, by which it was shown that four of these herds were in a satisfactory state of health at the time of applying the first test: The United States Soldiers' Home, the Government Hospital for the Insane, the Girls' Reform School, the Home for the Aged and Infirm, the National Training School for Boys, the Washington Asylum, and the Columbia Institution for the Deaf and Dumb. The test was also applied to the herd supplying milk to the United States Naval Academy at Annapolis, Md.

From the beginning of the work in the spring of 1907 up to the close of the fiscal year, June 30, 1908, the Bureau applied the tuberculin test to 2,468 cattle in the District of Columbia, Maryland, and Virginia, of which 387, or 15.68 per cent, reacted. Of the reacting animals, 126 were slaughtered under the Bureau's inspection, and in all but a single case the presence of tuberculosis was demonstrated on post-mortem examination. The diagnosis of the tuberculin test was therefore confirmed in 99.21 per cent of the animals slaughtered. Of the 126 animals killed under inspection, 94 were so very slightly affected as to be safely passed for food after removal of the glands or organs in which the lesions were found, while 32 were condemned.

Much of the growth of interest in the tuberculin test among cattle owners is probably attributable to the fact that instead of forcing the test upon them an educational policy has been pursued with a view to leading them to an appreciation of the significance of the dangers of tuberculosis among their cattle, and thus to a recognition of the economic importance of obtaining sound animals and the production of a wholesome milk supply. Another factor in the growth of this interest has been the demonstration of the accuracy of the tuberculin test when applied by the veterinary inspectors of this Bureau.

The form of agreement adopted for use in the tuberculin testing of cattle is set forth below. This is intended to represent the most liberal measures for the control of tuberculosis that are compatible with economic principles, aiming at the final eradication of the disease and the maintenance of a herd free from tuberculosis.

UNITED STATES DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY.

Agreement.

In consideration of the testing of my herd of cattle by the Bureau of Animal Industry of the United States Department of Agriculture, and the assistance of said Bureau in enabling me to produce and maintain a herd of cattle free from the contamination of tuberculosis, I, ________________________________,
(Name of owner.)
of ______________________________, owner of said herd of cattle, comprising
(Post-office address.)
____, do hereby
Number and kinds over 6 months old; number and kinds under 6 months old.
agree as follows:

1. I will cause all animals which react to the tuberculin test, and which also show other marked symptoms of tuberculosis, to be slaughtered within a reasonable time under the United States meat-inspection regulations, and I will cause the carcasses of said animals to be disposed of according to the meat-inspection regulations of the Bureau of Animal Industry, based upon the lesions found upon inspection.

2. I will cause all animals which react to the tuberculin test, but which show no other evidence of tuberculosis, either to be slaughtered and disposed of as herein provided for animals which show also other evidence of tuberculosis, or I will cause such animals to be removed from the herd and portion of the farm upon which the healthy animals of the herd are maintained, and I will cause the diseased animals to be segregated from the healthy animals, and thereafter they shall remain so segregated.

3. In all cases where the milk from such segregated reacting cows is to be used for any purpose whatever I will cause the said milk to be sterilized.

4. Segregated reacting bulls may be used for breeding, provided they are held on leash and are not permitted to leave the premises reserved for their use, and provided the healthy cows bred to such bulls are not unduly exposed to infected premises or to other diseased cattle.

5. I will cause the young from segregated reacting animals to be removed from their mothers at birth and will not permit the said young to suck their mothers.

6. Any part of my premises contaminated by reacting animals will be submitted by me to a thorough disinfection under the direction or supervision of the Bureau of Animal Industry.

7. All cattle owned by me, both healthy and tuberculous, I will mark, or allow to be marked, in such manner as to enable their identity to be retained, and I will not change the location of or slaughter any tuberculous cattle except after due and timely notification to the Bureau of Animal Industry, stating the exact nature of the change of location, or the exact date, name, and address of the official establishment at which the animal or animals are to be slaughtered.

8. I will add no cattle to the said herd which have not passed a tuberculin test administered by an authorized public agent qualified to perform such test or by an inspector of the Bureau of Animal Industry.

9. I will comply with all reasonable sanitary measures which are indicated by the proper officials of the State or Territory wherein my herd is located, or

by the local board of health under whose permit I am disposing of dairy products, or by the Bureau of Animal Industry.

In witness whereof I have signed this agreement this -------------- day of ------------, one thousand nine hundred and ------

----
Owner of the ------ herd.
(Address) --------------------

Witness:

VENEREAL DISEASE OF HORSES.

Notwithstanding the fact that the eradication of the disease of horses known as maladie du coït or dourine was believed to have been successfully accomplished a year or two ago, it has been considered wise to continue the inspection of horses in certain Western States where the disease formerly prevailed, to make sure that none of the contagion persisted. During the fiscal year the Bureau veterinarians made 2,884 inspections without discovering any case of the disease.

EXPERIMENT IN EFFECT OF SANITARY CONDITIONS ON TUBERCULOSIS.

In the latter part of the fiscal year a cooperative experiment was instituted with the Virginia Agricultural Experiment Station to determine the variation in the curative influence of fresh air and sanitation upon tuberculous cows kept under different conditions. Twenty tuberculous animals have been entered in the experiment, and these have been divided into three groups, two of which are being maintained under ideal sanitary conditions in new buildings constructed on economic principles, which can be used as models for the farmers. The remaining group, used as a check upon the other two, is kept in a poorly ventilated, insanitary barn, such as is seen upon some farms.

LIVE-STOCK DISEASES AND CONDITIONS IN PORTO RICO.

From August 8, 1907, until April 15, 1908, investigations of the diseases of live stock and conditions surrounding the live-stock industry were carried on in Porto Rico by Dr. William Thompson under the direction of the Quarantine Division.

The Porto Rican cattle are noted throughout the West Indies for their superior size and working ability. A majority of them show the effect of a cross with zebu blood, which resulted from the importation of a number of zebu bulls in 1858. This cross has lessened the milk yield, but has created an ox with a particularly strong neck and heavy frontal bones and horns, which are particularly valuable when the Spanish yoke is used. This yoke is placed across the forehead and lashed to the horns so that the animal is compelled to push its load rather than draw it. The zebu strain is also characterized by short hair, heavy dewlap, dependent sheath, and an attenuated, whip-like tail.

From 1901 to 1906 the exportation of Porto Rican cattle to other parts of the West Indies was quite extensive, there being exported during this period 65,915 cattle, which went principally to Cuba. On account of the free trade with the United States, the sugar crop has replaced cattle as a source of revenue to the natives, and as a consequence the cattle exports have now practically ceased.

The cattle all over the island of Porto Rico are infested with ticks, although the native cattle of the hill country carry a heavier infestation than those of the lowlands. The lowlands cattle show more conspicuously the effects of the zebu cross, and it is thought that these animals carry fewer ticks, because their short hair does not afford shelter for the development of the female ticks, but exposes them to the action of the tropical sun. Among the hills cattle deaths are recorded, resulting gradually from their heavy infestation with ticks.

United States cattle from Florida and points below the southern cattle fever quarantine line have been imported into Porto Rico without any apparent effect on the health of the native cattle or themselves, but cattle imported from the northern portion of the United States have died to the extent of 60 to 75 per cent. Owing to the warmth of the climate of Porto Rico, the ticks exist on the cattle throughout the entire year.

Blackleg is the all-prevailing disease of Porto Rican cattle. The Bureau vaccine has been introduced and is gradually growing in favor among the natives. Anthrax has been reported from some sections, but its existence in Porto Rico has never been proven.

The island is particularly fortunate in the fact that a diagnosis of tuberculosis has never been confirmed among the native cattle. Their greatest langer from this source would seem to lie in the possible importation of this disease with dairy stock from the United States.

Mange or scabies does not exist among either the horses or the cattle. Glanders and epizootic lymphangitis are quite prevalent among the horses and ponies of the island.

At the present time Porto Rico supplies its own needs for both food and work animals, and is neither importing nor exporting to an appreciable extent.

THE PATHOLOGICAL DIVISION.

Investigations in this Division have been continued under the direction of Dr. John R. Mohler, chief, and while its regular work in relation to rabies, blackleg, tuberculosis, glanders, and the examination of the carcasses of wild animals that have died at the National Zoological Park has been carried on as in former years, there has been much time devoted to matters which are not of a routine or customary nature.

SWAMP FEVER IN HORSES.

In cooperation with the Minnesota Experiment Station the investigations into this disease have been continued. Work has also been done at and near San Antonio, Tex., as the infection has proven as disastrous in those southern latitudes as it has in the colder climates of Minnesota and the Dakotas.

The facts relative to the transmission of the infection, which were mentioned in the report of 1907, have been fully substantiated by the investigations of the past season. Furthermore, it has been proved that guinea pigs, rabbits, dogs, and cattle are immune to the disease.

Experiments are now under way to determine the infectiousness of the urine and feces, the vitality of the virus, its transmission by feeding as well as by intermediate hosts, and the changes to be found in the blood and urine of infected horses.

Enlarged quarters have been recently acquired, which will permit the study of a greater number of affected animals, and the work can therefore be pushed to better advantage than under the less favorable conditions of the past.

GLANDERS.

The appearance of cases of glanders with considerable regularity among the horses and mules of the District of Columbia and vicinity serves to prove that the disease is well established in this region and that constant care will be necessary to hold it in subjection. The agglutination method of diagnosis has been used repeatedly during the year and with an increasing degree of satisfaction. Familiarity with its use will no doubt make it a valuable agent in the detection and eradication of glanders.

EPIZOOTIC LYMPHANGITIS.

This is a chronic contagious disease, caused by a specific organism, the *Saccharomyces farciminosus*, and is characterized by a suppurative inflammation of the subcutaneous lymph vessels and the neighboring lymph glands. The disease was first described by Italian and French veterinarians, and the specific organism was discovered by Rivolta in 1873. The presence of the disease in the United States was first observed by Pearson in 1907, although it is probable that it has existed in various parts of the country for many years. Its presence has also been established in Ohio, Iowa, North Dakota, and California, as well as in our island possessions (the Philippines, Porto Rico, and Hawaii).

CHRONIC BACTERIAL DYSENTERY OF CATTLE.

In March and April there were received at the pathological laboratory the large intestines of several cows which had died of a peculiar disease. These specimens showed thickening and corrugation of mucous membrane, with a few scattered hemorrhagic areas. Stained smears made from all these cases showed the presence of acid-fast bacteria, thicker and shorter than the avian tubercle bacillus, which fact, together with the history and symptoms of the affection, caused the diagnosis of chronic bacterial dysentery to be made. The disease is characterized by a chronic and progressive diarrhea, loss of appetite in the later stages of the disease, and marked emaciation, with anemia. This disease has only recently been recognized in this country, although there is no doubt that it prevails extensively. The course of the malady covers a period varying from two months to two years, according to the severity of each specific case. In 1904 Markus reported this disease in Holland, and subsequently it was observed in Belgium, Switzerland, Denmark, and Great Britain.

TUBERCULOSIS.

The immunizing experiments which this Division had previously inaugurated for the study of protective agencies against tuberculosis in cattle have been continued throughout the year, and a number of animals that had been inoculated with living human tubercle bacilli as a means of protection have since been slaughtered and examined. While many of these cattle have shown great and increased resistance to tuberculosis, no method has yet been found which is reliable enough to justify its general application to the tuberculous herds of the country.

The testing of infected butter has been continued, and in the later experiments of this nature the conclusions reached through former work have been confirmed. Tubercle bacilli will retain their vitality and virulence while in butter under common market conditions for at least five months.

EXHIBIT AT THE INTERNATIONAL TUBERCULOSIS CONGRESS.

During the year a call was sent out to the various cities at which Federal meat inspection is maintained, asking the inspectors to lay aside the most striking specimens of tuberculosis that they might chance to meet, especially those showing infection of mammary organs either in cattle or swine, later shipping them to the Pathological Division for preservation.

The response to this request was very hearty, and many rare specimens were received. These were properly hardened and then preserved in Kaiserling's fluids, and the choicest were placed in glass containers or mounted in gelatin for exhibition at the International Congress on Tuberculosis or at some later exhibition at which pathological specimens are shown.

TYPHOID BACILLI.

The viability of the typhoid bacillus has been investigated, both in butter and in milk. On the one hundred and fifty-first day after the manufacture of butter from milk infected with typhoid bacilli, living colonies of these bacilli developed on plates that were made from the butter. This proves that typhoid bacilli will retain their vitality under these conditions for one hundred and fifty-one days, and that during this period of time these micro-organisms are ready to multiply whenever placed in suitable environment.

The length of time that typhoid bacilli will remain active in milk under common market conditions far exceeds the length of time that it is ordinarily kept before being put to some domestic use. Examinations at repeated intervals showed that the organisms retained active motility for at least twenty days, whence we must conclude that milk offers an unsurpassed culture medium for the growth of typhoid bacilli, and that when once contaminated such milk continues to offer a menace to the people consuming it.

RABIES.

The Pathological Division has continued to examine all animals brought to the laboratory suspected of having rabies, and all dogs that have bitten anyone and been killed as a consequence. It was found that there had been a decided increase in the prevalence of rabies in the District of Columbia, so much so, in fact, that a muzzling order was issued by the District Commissioners in accordance with law, after the situation had been vigorously presented by the Secretary of Agriculture. A great number of stray dogs found wandering the streets were impounded and destroyed, and this, together with the muzzling order, has probably greatly impeded the spread of the disease. However, the disease is still present and will continue so long as unmuzzled, improperly muzzled, or unrestrained dogs are allowed to run the streets. A comparison of the number of cases shown in the appended table with the number given in the preceding year's report clearly shows that the disease was not only on the increase, but greatly on the increase, and justifies the enforcement of muzzling in spite of the protests made by some sympathetic owners of dogs who consider only the inconvenience to the dogs while manifesting an utter disregard for the safety of human life in the community. It still seems necessary to impress upon some people that rabies is not a fantasy, but a fact, and this has been brought home to more than one individual during the past year in the most convincing way through being bitten by his own or some vagrant rabid dog.

During the fiscal year ending June 30, 1908, there were examined the brains of 111 dogs, 2 cattle, 1 pig, and 3 cats. Of these, 77 dogs, 1 cow, 1 pig, and 3 cats were found to have been affected with rabies, and 61 of the rabid dogs were furnished by the District of Columbia, being over five times as many as last year. It was found that the most satisfactory method of diagnosis was by demonstrating the presence of Negri bodies in sections of the hippocampus major. The touch method of making preparations for examination for Negri bodies has not been uniformly successful in our hands, and in practically every case sections have been made of the brain tissues before staining. In only a few cases was it necessary to make inoculations of rabbits to arrive at a diagnosis.

Cases of rabies investigated by the Bureau of Animal Industry during the fiscal year 1908.

Date.	Record No.	Kind of animal.	Source.	Diagnosis by inoculation of rabbits.	Diagnosis by Negri bodies,	Diagnosis by changes in plexiform ganglia.	Persons or animals bitten.
1907. July 13	1129	Dog	District of Columbia.	Negative	Negative	Positive	1 child.
Do	1138	do	Bristol, Tenn	do	do	None made	3 dogs.
Do	1140	do	District of Columbia.	do	do	Negative	1 man.
Do	1149	do	do	None made[b].	None made[b].	None made[b].	None.
Aug. —	1187	do	do	do	Positive	do	1 woman, scratched.
Do	1190	do	Charleston, W. Va.	do	Negative	do	(a)
Do	1199	do	District of Columbia.	do	Positive	do	1 dog.
Sept. —	1208	do	Clover, Va	do	do	Negative	(a)
Do	1210	do	District of Columbia.	Negative	Negative	None made	(a)
Do	1211	do	Bethesda, Md	Positive	None made	do	2 dogs.
Do	1223	do	District of Columbia.	None made	Positive	Positive	(a)
Do	1226	do	do	Positive	do	do	(a)
Do	1228	do	do	None made	do	None made	None.
Do	1230	do	do	Positive	do	do	(a)
Do	1231	do	do	None made	do	do	1 child.
Oct. —	1265	do	do	do.[b]	None made[b].	do.[b]	1 man.
Do	1267	do	do	do	Positive	None made	None.
Oct. 29	1281	do	do	do	do	Positive	1 cow and several dogs.
Do	1283	do	do	do	do	do	1 boy.
Do	1286	do	do	do	do	None made	1 woman.
Oct. 30	1288	do	Silver Springs, Md.	do	do	Positive	2 dogs.
Nov. 4	1289	do	District of Columbia.	do.[b]	None made[b].	None made[b].	Several children and dogs.
Nov. 11	1301	do	do	do	Positive	Negative	1 man.
Nov. 16	1308	do	do	do	Negative	do	1 woman.
Nov. 18	1313	do	do	Positive	do	do	None.
Dec. 4	1335	do	Norfolk, Va	do	do	Positive	2 children.
Dec. 16	1342	do	District of Columbia.	None made	Positive	None made.	3 dogs.
Dec. 21	1354	do	do	do	do	Positive	2 persons and 3 dogs.
1908. Jan. 6	1373	do	do	do	do	None made.	1 man.
Jan 10	1380	do	do	Positive	do	Positive	Do.
Jan. 20	1391	do	do	None made	do	do	None.
Feb. 5	1415	do	do	do	do	do	Several dogs.
Do	1416	do	Tuxedo, Md	Negative	None made.	do	None.
Feb. 7	1419	do	Laurel, Md	None made.	Indeterminate.	do	Do.
Feb. 13	1433	do	District of Columbia.	do	Positive	do	(a)
Feb. 15	1435	do	Brierfield, Va	do	do	None made.	(a)
Feb. 17	1442	do	Herndon, Va	do	do	do	5 persons.
Do	1443	Steer	District of Columbia.	Negative	Negative	Negative	(a)
Feb. 18	1445	Dog	Charleston, W. Va.	do	Positive	None made.	(a)
Feb. 21	1449	do	District of Columbia.	do	Negative	Positive	(a)
Feb. 27	1458	do	do	do	do	Negative	1 boy.
Mar. 11	1477	do	Arlington, Va	None made.	Positive	Positive	None.
Mar. 14	1485	do	District of Columbia.	do	do	do	1 man.
Mar. 16	1488	Cow	Herndon, Va	do	do	None made.	(a)
Mar. 17	1492	Dog	District of Columbia.	Negative	Negative	Negative	1 man.
Mar. 18	1495	do	do	None made.	Positive	None made.	Dogs and 1 cat
Mar. 19	1496	do	do	Negative	Negative	Negative	1 boy.
Mar. 25.	1510	Dog	do	do	do	do	None.
Mar. 27.	1513	do	do	do	do	do	Do.
Apr. 8.	1533	do	do	None made.	Positive	None made	(a)
Do	1534	do	do	do	do	do	(a)
Apr. 14.	1542	Pig	Cedar Rapids, Iowa.	do	do	do	(a)
Apr. 15.	1545	Dog	District of Columbia.	Negative	Negative	Negative	1 girl.
Apr. 17.	1546	do	do	None made	Positive	None made	1 man.
Apr. 20.	1558	do	do	do	do	do	1 girl.
Apr. 22.	1566	do	do	Negative	Negative	Negative	1 boy.

[a] History incomplete, not indicating whether persons or animals had been bitten.
[b] Carcass too badly decomposed for experimental purposes.

Cases of rabies investigated by the Bureau of Animal Industry during the fiscal year 1908—Continued.

Date.	Record No.	Kind of animal.	Source.	Diagnosis by inoculation of rabbits.	Diagnosis by Negri bodies.	Diagnosis by changes in plexiform ganglia.	Persons or animals bitten.
1908.							
Apr. 21.	1575	Dog	District of Columbia.	None made.			Diagnosed in life.
Apr. 27.	1580	do	do	do	Positive	None made	1 man.
Do	1581	do	do	do	do	do	2 men.
Apr. 28.	1587	do	do	do	Negative	Negative	(a)
May 2	1591	do	Bethesda, Md	do	do	do	None.
May 4	1592	do	District of Columbia.	do	Positive	None made	3 boys.
Do	1593	do	do	do	do	do	1 man.
Do	1596	do	do	do	do	do	Several dogs and 1 man.
May 8	1603	do	Charleston, W. Va.	do	do	do	(a)
May 11	1609	do	District of Columbia.	do	None made	Positive	3 dogs.
Do	1610	do	Alexandria, Va	do	Positive	None made	2 children.
May 13	1614	do	Richmond, Va	Negative	Negative	Negative	(a)
May 14	1616	do	District of Columbia.	do	do	do	1 child.
May 15	1620	do	do	Positive	do	do	1 girl.
Do	1621	do	do	None made	Positive	None made	Dogs.
Do	1622	do	do	do	do	do	2 children.
May 16	1624	Dog	Lamar, S. C	Negative	Negative	Negative	(a)
May 18	1626	do	Alexandria, Va	None made	None made	Positive	1 man.
May 21	1635	do	District of Columbia.	do	Positive	None made	Do.
Do	1636	do	do	do	do	do	Do.
Do	1638	do	do	do	do	do	Do.
May 22	1639	do	do	do	do	do	Do.
May 23	1640	do	do	Negative	Negative	Negative	2 people.
May 25	1642	do	do	None made	Positive	None made	1 man and 1 dog.
Do	1643	do	Norfolk, Va	do	do	do	1 child.
Do	1644	do	District of Columbia.	Negative	Negative	Negative	Do.
May 26	1646	do	do	None made.	Positive	None made	None.
May 27	1648	do	Arlington, Va	do	do	do	3 dogs.
May 29	1649	do	District of Columbia.	Negative	Negative	do	(a)
May 30	1652	do	do	do	do	Negative	1 girl.
June 1	1655	do	do	do	do	do	1 boy.
Do	1659	Cat	do	do	do	do	1 man.
June 5	1660	Dog	do	None made.	Positive	None made	1 dog.
June 3	1662	do	do	Negative	Negative	do	2 persons.
June 4	1663	do	do	None made	Positive	do	1 dog.
June 5	1666	Cat	Bethesda, Md	do	do	do	(a)
June 6	1668	Dog	District of Columbia.	do	do	do	1 child and 1 dog.
Do	1669	do	do	do	do	do	1 man.
Do	1671	do	do	do	do	do	(a)
June 8	1672	do	do	Negative	Negative	Negative	Several dogs.
Do	1673	do	do	None made	Positive	None made	1 boy.
June 9	1677	do	do	Positive	Negative	Negative	(a)
June 10.	1682	Dog	do	Negative	do	None made	1 man.
Do	1683	do	do	None made	Positive	do	1 boy.
June 11.	1684	do	do	do	do	do	2 dogs.
June 12.	1685	do	do	Positive	Negative	do	1 boy.
Do	1686	do	do	Negative	do	do	Do.
June 13	1688	do	do	do	do	do	Do.
June 14	1689	do	do	None made	Positive	do	4 dogs.
June 15	1690	do	do	do	do	do	1 man.
Do	1691	do	do	do	do	do	2 persons.
June 16	1692	do	Glen Echo, Md	Negative	Negative	Positive	Do.
Do	1693	Cat	Tacoma Park, Md.	Positive	do	do	1 child.
June 18	1696	Dog	District of Columbia.	Negative	do	Negative	Do.
Do	1698	do	Upperville, Va	None made	Positive	None made	(a)
June 23	1700	do	District of Columbia.	Negative	Negative	Negative	2 children.
Do	1701	do	do	None made	Positive	None made	1 boy.
June 27	1704	do	do	do	do	do	(a)
Do	1705	do	Charleston, W. Va.	do	do	do	(a)
June 29	1707	do	District of Columbia.	do	do	do	1 dog.
Do	1708	do	do	do	do	do	None.

[a] History incomplete, not indicating whether persons or animals had been bitten.

DISTRIBUTION OF BLACKLEG VACCINE.

The free distribution of blackleg vaccine continues to be an important feature of the routine work of the Pathological Division. During the fiscal year ending June 30, 1908, about 1,200,000 doses of vaccine have been prepared in the pathological laboratory and distributed among stock owners. The great demand for this product shows the continued confidence of stock raisers in its value as an immunizing agent against this virulent disease.

The results of the vaccination for the year ending June 30, 1907, as reported to the Bureau by the stock raisers who have used the vaccine, are as follows:

Results of use of blackleg vaccine, year ending June 30, 1907.

State or Territory.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					
		Number.	Per cent.	Within 48 hours.	From 2 to 7 days after.	Within 1 year.	Total number.	Percentage of deaths after vaccination.	Number of cases due to mistakes.
Arizona	6,330	382	6.03	17	7	22	46	0.726	....
Arkansas	613	14	2.28	....	....	1	1	.163	....
California	53,740	465	.86	12	30	67	109	.2	1
Colorado	59,096	691	1.16	26	30	176	241	.373	20
Idaho	2,784	61	2.19	2	2	9	13	.43	1
Illinois	2,379	65	2.73	5	1	4	10	.42	....
Iowa	13,524	88	.65	4	4	57	65	.47	....
Kansas	36,791	492	1.33	12	16	68	96	.258	1
Kentucky	588	22	3.74	....	....	1	1	.17	....
Michigan	108	2	1.85	....	1	....	1	.85	....
Minnesota	1,189	62	5.13	1	....	1	2	.16	....
Mississippi	60	7	1.16	....	....	....	....	....	....
Missouri	17,928	190	1.05	1	9	39	49	.27	....
Montana	24,123	289	1.19	4	11	98	113	.44	6
Nebraska	115,830	1,932	1.6667	45	100	357	502	.428	6
Nevada	880	19	2.15	....	....	....	....	....	....
New Hampshire	11	....	....	....	....	....	....	....	....
New Mexico	15,897	458	2.87	9	13	143	165	1.03	....
New York	355	4	1.12	....	....	1	1	.27	....
North Carolina	1,919	43	.213	1	1	10	12	.62	....
North Dakota	35,298	467	1.32	7	13	135	155	.43	....
Ohio	18	....	....	....	....	....	....	....	....
Oklahoma	6,523	83	1.27	4	4	5	13	.197	....
Oregon	14,124	86	.6	....	2	16	18	1.27	....
Pennsylvania	24	1	4.16	....	....	....	....	....	....
South Dakota	45,559	878	1.92	20	53	237	310	.68	....
Tennessee	2,287	78	3.41	1	1	6	8	3.47	....
Texas	165,143	2,099	1.27	35	146	1,038	1,219	.737	1
Utah	1,854	48	2.52	....	2	....	2	.107	....
Vermont	58	5	8.6	....	....	1	1	1.72	....
Virginia	9,354	148	1.58	1	13	55	69	.73	....
Washington	777	43	5.53	1	....	....	1	.128	....
West Virginia	3,429	62	1.18	2	3	17	12	.34	....
Wisconsin	373	63	1.68	....	....	....	....	....	....
Wyoming	51,862	687	1.32	17	36	170	223	.429	....
Total and average	690,828	10,034	1.431	227	507	2,734	3,458	.50	36

An examination of the foregoing table shows, when compared with the records of previous years, a decrease in the percentage of animals dying of blackleg without being vaccinated, also in the number of animals dying subsequent to vaccination. Eliminating the number of cattle dying within forty-eight hours after vaccination, as a result of being previously infected, and those whose death has been due to mistakes in vaccinating, the number of cattle dying after vaccination is reduced to 3,195, or only 0.46 per cent. The annual losses to stock raisers previous to the use of blackleg vaccine ran as high as 10 or 12 per cent of all the calves raised in the infected districts.

AUTOPSIES OF WILD ANIMALS.

As heretofore, the large number of wild animals sent to the pathological laboratory by the National Zoological Park for autopsy presented many interesting pathological conditions. The results of post-mortems held on 112 animals show that diseases of the digestive and respiratory tracts are responsible for more than one-half of the deaths of the wild animals at the park. Tuberculosis was by no means rare, and especially was this true in the case of monkeys. Autopsies were performed on 15 monkeys, 10 of which died of tuberculosis. Post-mortems on birds revealed the fact that a large number of deaths were due to aspergillosis of the lungs. This was especially noticeable at the autopsies of aquatic birds—wood ducks, cranes, and flamingoes being particularly affected.

RAT VIRUS INVESTIGATIONS.

The ravages by rats and mice are of importance from an economic standpoint, but these animals also disseminate diseases, which fact has again been established in the recent outbreak of bubonic plague on the Pacific coast. This induced some of the commercial firms to prepare viruses with the object of producing an infectious disease which, while destructive to rats and mice, would prove harmless to all domesticated animals. There existed various such preparations on the market, but extensive tests with them proved their infectiousness for other animals besides rats and mice. Recently several new products of this kind were placed on the market, and, following requests from various sources, the Pathological Division undertook an investigation of these products in order to determine their effectiveness.

The samples for the test were purchased from local drug stores and the directions for their use were carefully followed. Three rats were given two large feedings of the virus and were then placed with three control rats, all in one cage. The same procedure was followed with guinea pigs, rabbits, chickens, and mice. There was no effect whatever noted from the feeding of these animals; they continued well and have failed to show the slightest indication of infection. Subsequently fresh rats and other test animals were given a subcutaneous inoculation with emulsions from the rat viruses, but this also failed to produce any noticeable disturbance in the health of the animals. Thus the experiments clearly demonstrated the ineffectiveness and unreliability of the preparations tested.

POULTRY AND BIRD DISEASES.

The number of birds and chickens brought to autopsy during the past year is considerably in excess of that of the year previous. The various diseases occur in about the usual proportions. Careful examinations of the intestines of all poultry examined has revealed the frequent presence of the protozoan organism *Coccidium tenellum*.

The most important feature of the continued investigation of white diarrhea of chicks has been the successful differentiation between what is frequently termed "incubator or brooder pneumonia" and cheesy inflammation of the ceca. The earlier studies in white diarrhea revealed the fact that the caseo-necrotic inflammation of the ceca—resulting in great distension of the blind pouches, white diarrhea, and death—was due to the presence of *Coccidium tenellum* and should be denominated coccidial typhilitis.

Quite a number of poultrymen were inclined to claim that the investigations were faulty in that they failed to note the presence of cheesy nodules in the lungs and sometimes throughout the body cavity. As it was quite evident that the nodules in the lungs were not caused by coccidia, careful examination was made of them and cultures taken from them, resulting, in about 95 per cent of all cases, in the cultivation of a mold, usually *Aspergillus fumigatus*, sometimes *A. glaucus*. Several opportunities having occurred to investigate outbreaks among chicks which had shown previous to death evidences of diarrhea, it was discovered that some of the outbreaks showed at postmortem only the nodular caseation of the lungs and no affection of the ceca. In these cases no coccidia were to be found in the intestines, whereas the cheesy nodules regularly revealed the mycotic disease.

It was thus established that what is commonly spoken of as white diarrhea in chicks really includes at least two diseases, which may sometimes occur simultaneously in the same bird. The cases characterized by cheesy foci in the lungs, called "lungers" by poultrymen, should be recognized as cases of pneumomycosis in chicks, produced most frequently by the mold *Aspergillus fumigatus*, and may therefore be designated as cases of aspergillosis. The cases characterized by distended and cheesy ceca invariably show the presence of coccidia and should therefore be known as coccidiosis.

SARCOMATOSIS IN CHICKENS.

During the year an increasing number of the chickens received at the pathological laboratory showed that death was produced by extensive distribution of sarcomatous growths. In most of the cases the intestines and the peritoneum were the seat of invasion. One instance, however, deserves special mention, inasmuch as the tumor fibrosarcoma in this case, destroyed not only the kidneys, but extended into the muscles of the back and of the legs.

WORK OF PATHOLOGICAL LABORATORY IN CHICAGO.

The work at the branch pathological laboratory located at Chicago, Ill., has steadily increased. The veterinary inspectors at the various stations tributary to Chicago have forwarded a large number of specimens for microscopical diagnosis.

Two specimens of special interest were new growths in the livers of sheep, one a multiple tumor (lieo myoma) springing from the middle coat (tunica media) of the arteries, the other a hypernephroma involving one lobe of the liver. It seems that such tumors occurring in the livers of sheep have not been previously reported in the literature dealing with pathological subjects. A very interesting pathological change was observed in the lung of a steer. In this specimen there was an ossification of the walls of the air vesicles; in places true Haversian systems were formed in the bony plates.

During the year it was observed by the veterinary and meat inspectors in Chicago that a large number of tongues of slaughtered cattle contained eroded areas of various sizes at the bottom of the dorsum cecum of the member. The tongues of 840 slaughtered cattle, ranging from two years of age to adult animals, were examined microscopically, and 100 were found to contain eroded areas. Sections from these were prepared for microscopical examination and 79 were found to contain awns or beards of grain or grasses which had penetrated into the tissue beneath. In 49 of these cases colonies of actinomyces were found growing either free in the tissue or around the penetrating end of the awn.

THE BIOCHEMIC DIVISION.

This Division, of which Dr. M. Dorset is chief, has been engaged during the year chiefly in the laboratory inspection of meat products, investigations concerning hog cholera, and tests of stock dips, besides continuing the preparation and distribution of tuberculin and mallein.

LABORATORY MEAT INSPECTION.

In the report for the fiscal year 1907 the establishment of a systematic laboratory inspection of meat food products was described. During that year a great portion of time was spent in properly organizing the work.

During the fiscal year just ended this laboratory inspection has increased greatly in thoroughness and has been shown to be necessary for the proper enforcement of the meat-inspection law. The various laboratories have examined during the past fiscal year more than 12,000 samples collected from establishments in all parts of the country. Of these samples approximately 5 per cent have been found to be in conflict in one way or another with the regulations governing meat inspection. These samples consisted of a great variety of substances, such as canned meats, cured meats, fresh meats, sausages, cooked meats, flours, lards, lard substitutes, miscellaneous oils and fats, including tallow, oleo oils, stearin, etc., pickling solutions, soups, preserving salts, coloring matters, and water used in the preparation of meats. The greater portion of these samples were taken from establishments having inspection, though a considerable number were taken from houses operating under certificates of exemption. A far greater proportion of the samples from houses operating under exemption certificates were found to be in conflict with the regulations than was the case with samples from houses having inspection.

A very small number of meats were found to contain prohibited preservatives. The preservatives found were usually sulphurous acid or its salts, and occurred in the vast majority of cases in fresh chopped meats from establishments operating under a certificate of exemption. In the case of canned meats the chief violations consisted in the presence of cereals without this being shown on the label. Occasionally it was found that goods of this character were short in weight. Lards, lard substitutes, tallows, oleo oils, stearins, etc., were found to be almost without exception labeled properly and in good condition. In one case at least the discovery of adulteration in lard resulted in the withdrawal of inspection from an establishment. A few products were condemned owing to unsoundness or the presence of dirt, but as a general rule the products submitted were found clean and wholesome.

During the fiscal year sanitary analyses were made of water supplies from 70 different establishments where inspection is maintained. These samples were collected in all cases where there was reason to suspect the unwholesomeness of the water used in the preparation of meats and meat food products. The examinations resulted in the condemnation of a considerable proportion of the samples submitted, and steps have been taken to remove the sources of pollution where this could be done, and where this was not practicable an entirely new water supply has been installed.

RESEARCH WORK.

In addition to the routine inspection of meats and meat food products a considerable quantity of research work has been carried out along the following lines:

The action of saltpeter upon the red color of meats.—The results of this work show that the red color of cured meats is due to the indirect action of saltpeter upon the coloring matter of the blood, the saltpeter being reduced and the hemoglobin of the blood entering into combination with nitric oxid to form nitric oxid hemoglobin, which is a stable red color.

The detection of beef fat in lard.—At the beginning of the laboratory inspection considerable difficulty was found in determining through existing methods the presence of small quantities of beef fat in lard. As a result of extensive trials a method was developed which is simple and which serves to reveal the presence of very small quantities of beef fat mixed with lard; this is now employed in the routine examination of this class of products, and it is expected that the method will be of value to others engaged in similar work. This method has been described in Bureau Circular 132.

The use of sulphur dioxid in smokehouses and storerooms.—Laboratory experiments showed that when sulphur is burned in closed compartments where meat is kept the sulphur dioxid which is liberated is absorbed by the meat, the amount absorbed depending directly upon the condition of the meat in regard to moisture. Fresh meats absorb sulphur dioxid in large amounts, while smoked meats take up very much less. Examinations have been made of hams from smokehouses which had been fumigated with sulphur dioxid while the meats were still hanging therein, and sulphur dioxid has been found even when the meats were comparatively dry, though not in large quantities. A careful inquiry was made concerning the necessity for the use of sulphur dioxid in preventing damage to meats by skipper flies, and as a result it was found that most of the packinghouse superintendents think this is unnecessary provided sufficient care is taken in screening the smokehouse and storerooms and in preventing the introduction of skipper flies through meats from the outside which are already infested.

THE PREPARATION AND COMPOSITION OF MEAT EXTRACTS.—A considerable amount of experimental and practical work has been conducted along this line, and a report of the results will probably be issued during the ensuing fiscal year.

ANALYTICAL METHODS.—In all cases where existing methods of analysis have been found unsatisfactory in any respect efforts have been made to improve the technique and methods of procedure.

INVESTIGATION OF CANNING METHODS.—During the year the question as to the proper disposal of slow-leaking cans was brought up for decision, certain packing houses claiming that they should be allowed to open and reprocess these cans provided they did not show evidence of changes discernible through the odor or general appearance. A careful study of cans of this character was made, and the following conclusions were reached:

1. The majority of slow-leaking cans contain bacteria which invariably set up putrefactive or fermentative changes in the contents of the cans.
2. The majority of slow-leaking cans, when incubated for ten days at a temperature of 100° to 110° F., will develop into "swellers."
3. Short-vacuum, overstuffed, and collapsed cans will not swell upon incubation provided there are no breaks in the tins.
4. The swelling of slow-leaking cans upon incubation is due to the formation of gases resulting from the growth of bacteria within the cans.
5. The product contained in slow-leaking cans is not a safe article for food even though it be reprocessed.

As a result of this investigation the reprocessing of slow-leaking cans has been prohibited. A paper reporting this work more in detail has been included in the Twenty-fourth Annual Report of the Bureau.

INVESTIGATION OF THE CAUSE OF MEAT SOURING DURING THE PROCESS OF CURING.—In addition to the importance of this question from a public-health standpoint, it is one of considerable moment to the packers, who suffer large losses through the condemnation of meats which become sour before the curing is completed. Extensive experiments under practical conditions to determine the effects of chilling meats for longer or shorter periods of time prior to their being placed in cure have been carried out, and the effect of overheating animals at the time of slaughter, together with the part played by certain diseased conditions, have been given extensive study. In conjunction with these practical experiments bacteriological examinations have been made of a large number of sour hams and of pickling solutions in which these were cured, and numerous bacteria have been isolated. These experiments have not yet been concluded. The effect of the bacteria isolated from sour hams and normal hams upon the curing process is now being studied.

BRANDING INK.

In the last annual report the statement was made that an ink had been devised to be used for marking inspected carcasses, but at that time this ink had not been given a thorough trial and the results of its use in practice could not be stated. During the past fiscal year 2,150 gallons of this ink were prepared and forwarded to all establishments in the United States where fresh meats are prepared under Bureau inspection. Inspectors in charge of establishments where this marking is carried out have reported almost without exception that the ink when applied with a properly made metal brand gives entirely satisfactory results. By far the greater proportion of these inspectors state that the ink is much superior to the labels which were formerly used for the same purpose. The total cost of the ink required for applying the inspection mark during the year, including labor and brands, was $2,866.

ANIMAL DIPS.

EXAMINATION OF DIPS OFFERED FOR OFFICIAL DIPPING.

During the year approximately 185 different samples of dips and dipping solutions have been sent to the Bureau for examination. These included 10 lime-and-sulphur solutions, 4 arsenic-and-sulphur solutions, 30 cresol dips, and 141 coal-tar creosote dips. The composition of many of these substances as shown by the formulas submitted was such as to preclude their use in official dipping under the regulations. A considerable number upon a preliminary examination showed imperfect incorporation of the ingredients or lack of proper emulsifying qualities. After eliminating a number for these causes there were submitted to a thorough chemical examination the following: Ten lime-and-sulphur solutions, 4 arsenic-and-sulphur solutions, 15 cresol dips (of which 10 were rejected), and 114 coal-tar creosote dips (of which 13 were rejected). At the close of the fiscal year there remained in the laboratory between 15 and 20 dips of all classes to be examined. A few samples of crude petroleum were analyzed, and a number of other miscellaneous analyses of related substances were executed.

A gratifying feature of this inspection of proprietary dips has been the marked improvement noticeable in the quality of coal-tar creosote dips. At the beginning of the year many very low-grade solutions were submitted which contained considerable proportions of water or other inactive substances. When the manufacturers realized that the proportions in which their dips would be permitted in official dipping depended exclusively upon the amount of active ingredients in their products, they at once found it to their interest to place on the market dips which would be as concentrated as possible, with inactive substances such as water eliminated. Although such concentrated dips when diluted for dipping are not more efficient as curative agents than one of less concentrated qualities which is diluted to a lower degree, it seems evident that the action of the Secretary of Agriculture in permitting the use of proprietary dips in official dipping under definite restrictions with respect to composition has been of benefit to both the manufacturer and the consumer, in enabling the former to sell his goods squarely on their merits and in assuring to the latter the opportunity to purchase these dips with some degree of confidence as to their action.

RESEARCH AND EXPERIMENTAL WORK.

The methods of analyzing coal-tar dips which were available at the time of the Secretary's order permitting such dips of certain compositions to be used in official dipping were far from satisfactory, and it became necessary to place these methods on a more scientific basis in order to enforce the regulations satisfactorily. A large amount of experimental work was carried out along these lines and a method was developed which is believed to give accurate and concordant results. This study and the results obtained have been published as Bureau Bulletin 107, prepared by Mr. R. M. Chapin, who conducted the research work.

The Biochemic Division has also cooperated with the Zoological Division in testing dips of various compositions upon cattle. For this purpose a total of 280 gallons of dip was prepared and analyzed. The final result of these experiments has not yet been determined.

HOG CHOLERA.

Satisfactory progress has been made in the work of producing a vaccine for hog cholera. A report of the experimental work was made in the last annual report. Since that time practical field tests of the method have been carried out on 50 different farms, a total of approximately 2,000 animals being vaccinated. On some of these farms the serum was administered alone and on others the serum was given simultaneously with a small dose of disease-producing blood. The herd conditions varied widely, though they may be classified roughly as follows:

(*a*) Herds in an infected district, but which were themselves free from disease.

(*b*) Herds which were known to have been exposed by contact with hogs sick of hog cholera, but which had not developed disease at the time of treatment.

(*c*) Herds in which hog cholera was present and hogs were sick and dying at the time of treatment.

In no cases were any of the ordinary methods of combating hog cholera by quarantine and disinfection employed. In cases where disease was present at the time of treatment or where it appeared subsequent to treatment, the treated animals were allowed to run with the sick animals along with a number of untreated animals which served as controls on the action of the serum. It will thus be seen that the success following the treatment can be attributed only to the action of the serum.

In herds where hog cholera appeared subsequent to treatment and which had not been exposed prior to treatment all of the vaccinated hogs remained well, while more than 64 per cent of the checks died. In the herds which had been exposed prior to treatment but which were apparently well at that time, only 4½ per cent of the treated hogs died, while approximately 90 per cent of the checks were lost. In the herds where the disease existed at the time of treatment 13 per cent of the treated animals succumbed, whereas 74 per cent of the checks died.

In view of these successful field tests, and as the method seemed cheap enough to warrant its practical use, invitations were extended to a number of the more important hog-raising States to send representatives to the Bureau experimental farm at Ames, Iowa, for the purpose of observing the work and also to consider plans for the practical application of this method of combating hog cholera. This conference was held at Ames on May 25, 1908, and there were present representatives from Iowa, Nebraska, Kansas, Arkansas, Missouri, Indiana, Ohio, Michigan, and Minnesota. These representatives expressed themselves as convinced that the method was worthy of an extensive practical application, and in a number of instances at least this work has been taken up by the States with a view to distributing the serum to the farmers by the proper State officials. Other conferences have been arranged for and it is hoped that this work will be well organized and that the different States will soon take up the production and distribution of the serum.

Aside from the foregoing work, a number of experiments dealing with various phases of the hog-cholera problem have been carried out, but these have not reached a point where a report of results is warranted.

SANITARY EXAMINATION OF WATER SUPPLY OF DAIRY FARMS.

This work consisted in the sanitary inspection of practically all the dairies which supply milk to the District of Columbia. In addition to the sanitary survey, chemical analyses and bacteriological examinations were made of all the water supplies. As a result of this work it was found that a large number of dairies were using water which was questionable in so far as its sanitary condition was concerned. In every instance the dairymen were instructed as to the best methods of improving the water supply, and the result of this work has been that the insanitary conditions of many wells and springs supplying these dairies have been rectified. The data obtained in this work have been embodied in papers prepared for a report upon milk issued by the United States Public Health and Marine-Hospital Service and for the Yearbook of the Department of Agriculture for 1907.

WORK WITH DISINFECTANTS.

A considerable amount of bacteriological work has been carried out with coal-tar disinfectants, especial attention being given to coal-tar hydrocarbons. This work, while it has progressed satisfactorily, is not yet in such condition as to warrant a report, though it may be said that the examinations up to the present time show that the constituents of coal-tar disinfectants, other than cresols and related bodies, are practically without bactericidal effect.

TUBERCULIN AND MALLEIN.

The experiments concerning a standard method for the preparation of tuberculin have been continued and considerable progress has been made. The distribution of tuberculin to State, county, and city health officers has been continued, the demand having increased considerably during the past year. The total amount of tuberculin shipped out during the fiscal year just ended was 213,015 doses, as compared with 129,050 doses during the preceding year. All reports upon this subject indicate that the tuberculin prepared and distributed by the Bureau has been of good quality and has given uniformly successful results.

The distribution of mallein to health officers has also been continued, and 52,556 doses were distributed during the fiscal year. This exceeds the amount sent out during the previous fiscal year by more than 10,000 doses.

THE ZOOLOGICAL DIVISION.

This Division, under Dr. B. H. Ransom, as chief, has continued its work of investigating animal diseases of parasitic origin, collecting and determining animal parasites, and preparing publications relating to these subjects.

ROUNDWORMS OF SHEEP.

The investigations concerning roundworms parasitic in sheep, with special reference to the twisted stomach worm, have been continued. The experiments carried on in 1908, and which were uncompleted at the close of the fiscal year, have concerned the problem of keeping lambs free from infestation with these parasites. Two methods of handling the sheep have been tried. In one the lambs and their worm-infested mothers were kept together and changed at intervals to different pastures, the lambs when weaned being placed finally in a pasture separate from the ewes. In the other method the ewes and lambs were kept separate in adjacent pastures with a bare earth pen between, into which the lambs were frequently turned with the ewes for sucking, the animals afterwards being returned to their proper pastures. In addition another set of experiments is in progress in which an attempt is being made to determine the effects of feeding tobacco upon parasitic infection in sheep.

It is planned to provide during the coming year for practical trials, under farm conditions, of methods for avoiding the infestation of sheep with parasites, in case the results of the experiments now in progress at the Bureau Experiment Station are sufficiently favorable to justify such extension of the work.

GID IN SHEEP.

The investigation of this important parasitic disease, due to a tapeworm cyst found in the brain as a result of infection with eggs of tapeworms from dogs, has been continued along the lines mentioned in the last report. As yet no definite reports of the existence of this disease in other States than Montana have been received.

SHEEP SCAB.

A set of experiments in the treatment of sheep scab supplementary to earlier experiments in cooperation with the Biochemic Division of this Bureau and the South Dakota Experiment Station came to an untimely end on account of the destruction of nearly all the experimental sheep by dogs. A kerosene mixture tested as a remedy for sheep scab at the South Omaha Stock Yards proved to be unsatisfactory for this purpose. A bulletin relative to sheep scab is in preparation.

CATTLE MANGE.

A series of experiments in the treatment of cattle mange, with reference to the efficiency of coal-tar dips for this purpose, has been begun in cooperation with the Biochemic Division of this Bureau and the South Dakota Experiment Station.

INVESTIGATIONS BEARING ON TICK ERADICATION.

Experiments in the treatment of cattle for ticks with various substances applied by means of dipping vats and spraying machines have been carried out. These experiments demonstrated that a 20 per cent emulsion of some kinds of crude petroleum is very effective when applied by means of either a dipping vat or a spraying machine, only a small fraction of 1 per cent of the ticks surviving the treatment. A few animals which were treated a second time forty-eight hours after the first application were entirely freed of ticks. The injury to the cattle by the treatment was exceedingly slight and of no practical importance.

One kind of crude oil which was tried failed to give good results. It emulsified with difficulty and killed only a small proportion of the ticks. Various percentages of cresylic acid combined with kerosene, and with the kind of crude oil just mentioned, in emulsion with water failed to kill more than a part of the ticks, even when the percentage of cresylic acid was raised to a point at which it poisoned (but not fatally) the cattle treated.

Next in efficiency to an emulsion of a crude oil of proper composition was an arsenical solution containing nearly 0.2 per cent of arsenic by weight and 0.2 per cent of pine tar by volume. In this case also only a small fraction of 1 per cent of the ticks survived the treatment. The injury to the cattle was perhaps even less than that noted when oil emulsion was used.

These experiments indicate that from the standpoint of tick eradication both the oil emulsion and the arsenical solution are valuable agents for the purpose of destroying ticks on cattle. It is believed that, by repetitions of the treatment at proper intervals, even though some few ticks may occasionally survive, extermination of the ticks in pastures where the cattle are thus treated may be finally accomplished. In view of the fact that some ticks are likely to survive the treatment with oil emulsion or arsenical solution, it is evident that these preparations can not be safely employed for cattle which are to be moved from quarantined areas except for slaughter. Whether repetition of the treatment within a few days following the first treatment would be sufficient to render such movements of cattle safe is a subject for further investigation.

The first year's work in investigations bearing on tick eradication which have been conducted in cooperation with the Alabama Agricultural Experiment Station and the Alabama Live Stock Sanitary Board has been completed, but the results have not yet been compiled.

INVESTIGATIONS CONCERNING PARASITIC PROTOZOA.

The existence in the United States of various diseases of domestic animals due to parasitic protozoa demands that this class of parasites receive more attention than has heretofore been given to them in this Division. To supply this need an assistant, who will be employed in investigations in this field, has been appointed.

INDEX-CATALOGUE OF MEDICAL AND VETERINARY ZOOLOGY.

Parts 18, 19, and 20 of this catalogue have been issued during the year, and the first part of the subject-catalogue, comprising the Trematodes, which has been prepared in cooperation with the Division of Zoology of the Hygienic Laboratory, United States Public Health and Marine-Hospital Service, has been issued as Bulletin 37 of that laboratory.

COLLECTION OF PARASITES.

The total number of specimens in the helminthological collection of the Bureau is now more than 5,000, consisting of over 3,000 bottles and about 250 jars of material preserved in alcohol, and more than 2,000 microscopic slides. The constant growth of this collection has made it necessary to devote more and more time to its care. During the past year 528 new entries were made in the catalogue of this collection, about 100 of which represent specimens sent in for identification, most of the remainder having been collected by members of the Zoological Division. During the fiscal year about 130 post-mortem examinations of various animals, domesticated and wild, have been made with reference to the existence of parasitic infection.

Various educational institutions and scientific investigators have been supplied with duplicate specimens from the collection, and a a number of specimens have been received in exchange.

THE EXPERIMENT STATION.

The general character of the work at the Bureau Experiment Station during the past year has been similar to that of former years, consisting of independent original investigations as well as investigations in cooperation with the other scientific divisions of the Bureau. The station, which is located at Bethesda, Md., and is in charge of Dr. E. C. Schroeder, superintendent, provides facilities for work of a kind that requires farm and field conditions not obtainable within the city.

TUBERCULOSIS.

On the subject of tuberculosis two circulars, Nos. 118 and 127, were published. In the former the observations made relative to apparently healthy but dangerously tuberculous cows were discussed, and in the latter circular investigations were reported regarding the length of time tubercle bacilli remain alive and virulent in dairy products, and especially in butter. Two papers dealing with tuberculous infection through milk were also prepared by the superintendent of the station and presented respectively at meetings of the New York milk committee and the American Association of Medical Milk Commissions.

It is now known from the work of the Experiment Station that apparently healthy cows are frequently affected with tuberculosis; that about 50 per cent of such tuberculous cows scatter tubercle bacilli from their bodies; that the commonest channel for the elimination of tubercle bacilli from the bodies of tuberculous cattle is per rectum with the feces, and that ordinary market milk contains cow feces in varying quantities so commonly that it is no exaggeration to say that very little such milk is sold that does not contain at least a trace of cow feces. The conclusion follows logically from these facts that it is impossible to obtain milk at all times free from tubercle bacilli either from tuberculous cows directly or from healthy cows that are stabled, pastured, or otherwise permitted to come into contact with tuberculous cows or the material that passes from their bodies.

Relative to butter, it was shown that tubercle bacilli may remain alive and virulent in ordinary salted butter fully one hundred and sixty days, or five and one-third months, and that at the end of three months they show only a doubtful reduction in pathogenic virulence.

A large number of samples of commercial or market milk from various dairies supplying milk to the city of Washington were tested in the course of the year, and something more than one sample out of every twenty was found to be infected with tubercle bacilli. It was also discovered that dairies which distribute milk infected with tubercle bacilli do so intermittently and not continuously or uninterruptedly. For example, one dairy, tested on ten consecutive days, was found to be distributing infected milk on the second, third, and eighth days, and milk apparently free from tubercle bacilli on the remaining seven days. When this intermittent occurrence of tubercle bacilli in the milk from infected dairies is taken into consideration, we may reasonably conclude that the presence of infection in about 5 per cent of the samples of milk examined at the station is a much more serious condition than it at first appears to be. If it is necessary to examine from three to five samples of milk from a dairy to determine the fact that the dairy is distributing tuberculous milk, then the occurrence of tubercle bacilli in five samples among a hundred from 100 different dairies implies that from three to five times five dairies, or from 15 to 25 among the hundred, intermittently distribute tuberculous milk. This is very important, because the number of infected dairies, rather than the percentage of infected milk, determines the extent to which the public is exposed to virulent tubercle bacilli through the use of milk and dairy products.

The intermittent occurrence of tubercle bacilli in the milk of infected dairies is a condition parallel to the intermittent passage of tubercle bacilli from the bodies of cows per rectum with the feces. The station has shown that cattle affected with tuberculosis may pass enormous numbers of tubercle bacilli with their feces for two or three days, and then fail to pass them in numbers sufficiently large to enable their detection for a period of time varying from a few days to several weeks.

In Circular 118 it was shown that over 40 per cent of the animals in a herd of apparently healthy but tuberculous cattle were found to be passing tubercle bacilli from their bodies per rectum. These same cattle have now been under observation for about two years. With the exception of one or two, they have still the appearance of health, but the number passing tubercle bacilli per rectum has increased to nearly 90 per cent. The careful examination of additional cattle, apparently healthy but tuberculous, has confirmed the earlier conclusions regarding the dangerous manner in which cows that are not suspected to be tuberculous until they are tested with tuberculin may scatter tubercle bacilli.

Further confirmatory evidence has been obtained regarding the important rôle played by the feces of tuberculous cattle in the production of tuberculosis among hogs. Experiments have been and are now in progress to determine the extent to which the increasing prevalence of tuberculosis among hogs may be due to tuberculous brood sows.

A considerable amount of work has been done relative to the resistance of tubercle bacilli to natural germ-destroying agents, such as drying, sunlight, ordinary daylight, artificial light, etc. This work shows that exposure of tubercle bacilli to direct sunlight for very short periods of time wholly destroys their pathogenic character and probably kills them. Daylight, artificial light, and simple drying are much slower in their germicidal action.

Investigations relative to the immunization of cattle against tuberculosis and for the treatment of cattle affected with tuberculosis are still in progress. This latter work is being done by the station in cooperation with the Pathological Division.

RABIES.

One case of rabies that occurred in a horse merits special attention, in view of the prevalence of this disease in and near the District of Columbia. The horse was bitten June 4, 1907, brought to the station June 5, remained well until September 25, and was killed on September 26, after it had fractured one of its hind legs during violent paroxysms of acute rabies. The dog that bit the horse was shown by the Pathological Division to have been affected with rabies. The time that elapsed after the horse was bitten before it developed rabies was one hundred and thirteen days, or nearly four months. The horse was kept under conditions which absolutely excluded its infection with the virus of rabies after it reached the station.

TUBERCULIN TESTS.

For some time the station has been preparing to test the various brands of commercial tuberculin commonly sold in the United States. The facilities are so far completed that it is hoped the necessary tests can soon be made and a publication prepared designating the brands of tuberculin found reliable and those found unreliable.

OTHER INVESTIGATIONS.

Investigations relative to infectious abortion, sheep scab, loco of sheep, gid, internal and external parasites of sheep, Texas fever (including the life history of the micro-organism of Texas fever), swamp fever, anthrax, blackleg, hog cholera, etc., have been conducted during the year and are still in progress.

The infectiousness of the progeny of cattle ticks that matured on a sheep was tested by placing them on cattle. The cattle did not contract Texas fever, and hence it is assumed that cattle ticks grown on other hosts than cattle are free from Texas-fever infection. This assumption is strengthened by the fact that the progeny of cattle ticks that matured on donkeys were found a number of years ago at the station to be noninfectious.

The evidence we have that cattle ticks grown on other hosts than cattle are not carriers of the infection of Texas fever should not lead to the mistaken conclusion that such ticks can be ignored in tick-eradication work. Noninfectious cattle ticks become again infectious by growing a single generation on the body of a southern cow immune to Texas fever, or on the body of any bovine animal that has at some time been affected with and has apparently recovered from Texas fever. Cattle recovered from, and cattle immune to, Texas fever present, in the strictest sense of the word, chronic cases of Texas fever, and constitute the main and probably the only source from which cattle ticks derive the infection they carry.

INVESTIGATIONS IN ANIMAL BREEDING.

In cooperation with the Animal Husbandry Office of the Bureau, careful investigations regarding the laws of heredity are being made at the Experiment Station, with special reference to the applicability of Mendel's law of heredity to animals. The subjects of inbreeding, telegony, sex control, selective breeding, cross breeding, and the production of useful new hybrids are also being carefully studied. This work is constantly growing and promises in time to give results of importance. One zebra-donkey hybrid was born at the station in the course of the year, but the little animal was too weak to live. Several donkeys are now heavy with foal to the first zebra used at the station. The attempts made to impregnate mares from the zebra have thus far failed, but it is hoped that this branch of the hybrid investigations will give better results in the future.

GENERAL ROUTINE WORK.

The general routine work of the station during the year has been the same as in other years. A number of local outbreaks of disease have been investigated, many tons of green feed have been raised, and a large number of rabbits, guinea pigs, rats, etc., have been bred for the use of the Bureau and its various divisions.

THE ANIMAL HUSBANDRY OFFICE.

The Animal Husbandry Office, under the direction of Mr. George M. Rommel, Animal Husbandman, has continued its work relating to the breeding and feeding of live stock and poultry, the supervision of pedigree record associations, etc.

HORSE BREEDING.

COLORADO WORK.

The experiment in breeding American carriage horses, which is being carried on at Fort Collins, Colo., in cooperation with the Colorado Experiment Station, continues to progress in a highly satisfactory manner. The cooperation is now arranged so that it is practically equal, the station and the Bureau sharing expenses.

The stallion Carmon is in excellent condition and his colts are developing well. This year two 2-year-old sons of Carmon (Albion and Alva) are being used for breeding to a limited extent. In March, 1908, the purchasing board selected four mares in Kentucky to add to the stud. They were very fortunate in getting not only good individuals but mares whose breeding has been proved to be probably the best for carriage purposes known in Kentucky.

On July 1, 1908, there were in the stud 1 aged stallion, two 2-year-old stallions, two 3-year-old geldings, four 2-year-old geldings, 22 aged mares, eight 2-year-old fillies, 5 yearling colts, 1 yearling gelding, 7 yearling fillies, 5 colt foals, and 6 filly foals.

During the year one mare died from a broken blood vessel, one yearling colt died from a blood clot in the heart, and one yearling filly and one yearling colt were destroyed on account of unsoundness.

Certain of the mares which have been found to be undesirable for further breeding will be culled out, and the board of survey is also expected to pass on the desirability of the retention of certain of the young stock.

VERMONT WORK.

The improvement of the Morgan horse farm at Middlebury has been carried on rapidly during the year. The house was thoroughly repaired and is now a creditable and very convenient farm house. Certain repairs have been made to the barn in the way of renovating the basement, putting in a concrete floor and new stalls, and improving ventilation. Considerable fencing was done during the year, but there is still a large amount to be done, and shelter must be provided to take care of the increase from the stud.

The stallion General Gates was purchased July 1, 1907, as indicated in the previous report, and at the same time the filly Ellen Gates was bought. Two mares were purchased in October—Marion Gates and Carrie Gates—both daughters of General Gates. Exhibits of horses from the farm were made at the Addison County Fair at Middlebury in August, 1907, and at the Vermont State Fair at White River Junction during the first week in October. They attracted a large amount of favorable attention.

The number of horses in the stud on July 1, 1908, was as follows: One aged stallion, 10 mares, two 3-year-old fillies, one 2-year-old filly, 5 yearling fillies, 1 yearling gelding, 2 colt foals, and 3 filly foals.

Losses during the year were one yearling filly from tetanus, and one mare and one yearling filly destroyed on account of unsoundness.

This work is being carried on in cooperation with the Vermont Experiment Station.

IOWA WORK.

The Iowa work in horse breeding, in cooperation with the Iowa Experiment Station, is an experiment to evolve a breed of American draft horses, using as foundation animals gray Shires and Clydesdales. The work was inaugurated during the summer of 1907, when eight horses (five Shires and three Clydesdales) were selected in Great Britain by Prof. W. J. Kennedy of the experiment station.

The Department at the time paid for three of the Shire mares and has since arranged to pay for all the horses of this importation.

Since their arrival at the station the horses have done very well, but no foals have yet been obtained. Five of them were exhibited successfully at the International Live Stock Exposition at Chicago in December, 1907. This season all of the mares have been bred to the Clydesdale stallion Kuroki.

The horses on hand on July 1, 1908, were as follows:

Clydesdales.

Kuroki 13214, foaled April, 1903, bred by John Young, Dalbeattie, Scotland.
Grey Pearl 13215, foaled April, 1902, bred by Thomas Gordon, Keith, Scotland.
Rose of Brownfield 13216, foaled May, 1899, bred by Major Bedford, Ecclefechan, Scotland.

Shires.

Dapple Tom 9137, foaled 1904, bred by John H. Marshall, Mamham Hall, Newark, England.
Madresfield Beckford 9141, foaled 1905, bred by Earl of Beauchamp, Malvern, England.
Madresfield Alice 9138, foaled 1904, bred by Earl of Beauchamp, Malvern, England.
Kirby Bedon Firefly 9140, foaled 1904, bred by Garrett Taylor, Monvich, England.
Burford Mettle 9139, foaled 1905, bred by Alexander McIntyre, Lymm, England.

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The steps taken during 1907 for the inauguration of a uniform classification for American carriage horses at State fairs were supplemented by a systematic campaign to put this classification into effect at State fairs generally in 1908. The efforts of the Bureau and the American Association of Trotting Horse Breeders were highly successful, and twelve fairs adopted the classification in whole or in part for the 1908 season. In addition to these the Blue Grass Fair, held at Lexington, Ky., has adopted the classification used by it in 1907, which, although somewhat different in form from that recommended by the Bureau, is the same in purpose. At the fairs in 1907 where classifications were offered for American carriage horses, a Bureau representative was present and reported that in the main the showing was satisfactory. Although the exhibits were not all that could be desired, they were all that could be expected under the circumstances. At the Blue Grass Fair they were of a high order of excellence. The work of the present year will test this movement thoroughly, and every effort is being made to assist the fairs, in a legitimate way, to have successful exhibits. As was done last year, a representative of the Bureau will be present at each fair offering the classification.

At the annual meeting of the committee having this work in charge, held in Chicago November 18, 1907, the specifications were revised somewhat and the entire matter has been republished as Circular 113 revised.

SHEEP BREEDING.

During the past year the cooperative work at the Wyoming Experiment Station for developing a breed of range sheep has been progressing well. Owing to the very severe weather during the lambing season, a rather large number of lambs were lost. At shearing time 123 lambs were recorded, 57 ewe lambs and 66 ram lambs.

The 258 head of ewes averaged 10.5 pounds of wool, though a large number of them had only about a ten-months' fleece.

On July 1, 1908, there were 247 ewes, 123 lambs, and 6 rams in the flock; a total of 376.

BREEDING MILKING SHORTHORN CATTLE.

The work in breeding milking Shorthorn cattle has progressed slowly in Minnesota during the past year. Two meetings were held with the cooperators, and an organization was formed with a president and a secretary. An attempt was made to have listed and tested for tuberculosis all cattle intended to be in the experiment, and as a result of the tuberculin test two cooperators lost all stock entered, the presence of tuberculosis being shown. There are left in the cooperation only four herds, one of them being the herd of the university farm. These four herds promise well and should form a good foundation for future work. They comprise in all about 50 head of cows and 3 dairy-bred Shorthorn bulls.

Since the close of the fiscal year a circuit superintendent has been employed to give his entire time to the supervision of the herds and to keeping the breeding and milking records. The plan is for the superintendent to make his headquarters at the Minnesota Experiment Station and visit each herd once a month, spending three days at each place. During this time it is planned to have him check up the records and advise owners in regard to the management of their herds, etc.

GENERAL ANIMAL BREEDING INVESTIGATIONS.

Certain experiments in animal breeding are being carried on by cooperation between the Animal Husbandry Office and the Bureau Experiment Station. This work includes the study of Mendelism with rats and the study of inbreeding and selection with guinea pigs. About 1,200 small mammals are being used in these experiments. No results have been obtained as yet which would warrant publication.

As a basis for the study of telegony, some white bull terriers have been purchased and will be bred pure six generations, after which time, if no evidence is present that the original dogs were not strictly purebred, steps will be taken to test the question of telegony.

In June, 1908, one of the burros used in the zebra hybrid experiments gave birth to a foal by the President Grévy zebra Dan. Unfortunately, the little animal was exceedingly weak at birth and lived only a few days, although earnest efforts were made to save it. The carcass was sent to the Smithsonian Institution for mounting.

In April, 1908, two young female Grévy zebras were received direct from Abyssinia through the courtesy of Hon. R. P. Skinner, American consul-general at Marseille, France. They arrived in excellent condition, are quite easily handled, and one of them has been already bred to Dan. The Bureau now has one male and two female zebras[a] which are the Department's property.

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[a] One of the females has since died.

ANIMAL NUTRITION INVESTIGATIONS.

The investigations in animal nutrition have, as in previous years, been carried on in cooperation with the Pennsylvania State College. Heretofore that cooperation has been specifically with the agricultural experiment station. On July 1, 1907, the work of the college in animal nutrition was reorganized as an independent department under the name of the Institute of Animal Nutrition, of which the former director of the experiment station was made director, and the cooperation of the Bureau during the past year has been with this institute.

During the year office and laboratory accommodations for the institute, connecting with the respiration calorimeter building, were provided in the new agricultural building, the contract for the latter including also the principal permanent fixtures. At the same time a considerable amount of apparatus and several valuable sets of physiological journals, purchased during previous years for the work in animal nutrition, were transferred from the experiment station to the institute. The latter, therefore, began its independent existence with a fairly good equipment in addition to the respiration calorimeter and its accessories.

EXPERIMENTS IN BEEF PRODUCTION.

GENERAL.

The investigations in cooperation with the Missouri Agricultural Experiment Station may be divided for convenience into (1) winter-feeding experiments, and (2) full feeding of cattle on bluegrass pasture.

The winter-feeding experiments of 1907–8 were designed to determine (*a*) the economy of grain on cattle of different ages, and (*b*) the relative efficiency of corn and timothy hay, corn and clover hay, and corn, clover hay, and silage. Cattle of four ages were full fed during the winter. Fifteen cattle of each age were used, and those of each age were subdivided into three lots, one lot of each age receiving the same ration. It was thus possible to make a comparison of rations and also a comparison of the economy of beef production with cattle of different ages. The general plan of this investigation involved the feeding of the cattle of each age until they were finished for slaughter.

In the second investigation, during the summer of 1907, yearling and 2-year-old cattle were finished on bluegrass pasture. The investigation involved the comparison of rations composed of corn and linseed meal in varying proportions. These rations were fed to both yearling and 2-year-old cattle.

The investigations have yielded important results on the following factors in beef production:

1. The economy of gain as influenced by the age of the cattle.
2. The economic value of nitrogenous supplements to corn.
3. The best amounts of supplements to feed with corn.
4. The influence of condition on the economy of gains.
5. The economic value of silage for fattening cattle.
6. The comparison of different kinds of roughage for fattening cattle.

7. An economic comparison of full-feeding cattle in winter and summer on bluegrass pasture.
8. The length of time required to finish cattle.
9. The relative importance of the various factors such as season, ration, age, and kind of cattle on economic beef production.

SOUTHERN BEEF PRODUCTION.

The experiment with the herd of Mr. John S. Kernachan, of Florence, Ala., carried on as part of the cooperative work with the Alabama Experiment Station, with a view to showing what can be done under farming conditions to improve the native cattle for beef purposes, was brought to a close April 15, 1907, because of the discovery of tuberculosis in the herd. At that time the herd consisted of 70 head of grade Angus cattle. Fourteen steers were sold during the course of the year, directly off of the grass, at 3 cents a pound.

There had been from time to time an unusual number of deaths in the herd, which had been attributed to Texas fever, but the symptoms finally pointed to tuberculosis. A diseased organ of one of the cows was sent to Dr. C. A. Cary, of the Alabama Experiment Station, who pronounced the disease tuberculosis, and late in 1907 the tuberculin test was applied to the entire herd by Dr. D. C. Hanawalt, of the Bureau, with the assistance of Prof. Dan T. Gray, of the station, and 40 per cent of the cattle reacted. Mr. Kernachan is taking steps to eradicate the disease, with the assistance of the Quarantine Division of the Bureau. The results of the last year's work are being compiled for publication.

As a part of the cooperative work with the Alabama Station, feeding experiments are being carried on at the farm of Mr. O. E. Cobb, Sumterville, Ala. This work is under the supervision of Mr. W. F. Ward and involves two general problems: (1) To determine whether it would be a profitable thing to supplement the ranges as they are found in western Alabama and eastern Mississippi with a partial ration of hay or cotton-seed products in the winter time, and (2) to study the subject of finishing beef cattle on southern pastures, and at the same time to compare some of the cotton by-products as supplements to the pastures. The first part of the work was carried on during the winter, 81 steers being used. They were divided into three lots, one of which was given no feed except what could be obtained from the range; the second lot was fed, in addition, cottonseed meal and hulls, and the third lot cowpea hay. The second part of the work was begun when the grass came in the spring and was still under way at the close of the fiscal year. Four lots of steers, aggregating 144 in number, were used. The results will be compiled later.

Plans are under way to enlarge the southern beef-production work by extending the investigations into other States in the South, preferably in tick-free territory.

FEEDING COTTON-SEED PRODUCTS TO HOGS.

The effect of fermented cotton-seed meal when fed to hogs was studied again in the summer of 1907 without any positive results. The hogs were unthrifty, but none died, and it was impossible to tell whether the fermentation of the meal had any effect whatever. The experiment is being repeated. Next year it is expected to begin with feeding hogs on cotton-seed products in connection with alfalfa pasture.

INVESTIGATIONS OF ANIMAL FIBERS.

A study of animal fibers has been undertaken, and a collection of samples and fleeces of wool from different breeds of sheep and market grades and classes is being made. This work is expected to have an important practical bearing on the range sheep-breeding work in cooperation with the Wyoming Experiment Station.

POULTRY INVESTIGATIONS.

MAINE WORK.

The cooperative poultry work in connection with the Maine Agricultural Experiment Station, begun in 1904, has been continued during the past year. The experiment to determine the influence of floor-space allotment has been carried on for about four years, and as the results have been nearly uniform it has seemed unnecessary to continue the experiment beyond the current year (1908). The results of this experiment are being prepared for publication.

At the end of the current year there will also have been completed at the Maine station ten consecutive years' work in breeding for increased egg production. The results of this work show that for the entire period there has been no increase in average egg production, but rather a slight decrease. Therefore it has been deemed unwise to continue breeding by the same methods which have been followed in the past, namely, the selection of females on performance alone and of males on the performance of their dams. The future breeding work will be conducted in such a manner that both parents of the birds used will be known, and selection will be made accordingly. The records of the pullets will be kept in such fashion that the centgener power of each pair of parents will be known. The centgener power of the males used in breeding will be determined by using them in the breeding pens for at least two years. It is also proposed to introduce new blood into the barred Plymouth Rock stock of the station by putting into certain breeding pens cockerels from other high-laying strains of the barred Plymouth Rock. It is further planned to try in successive years new breeds of fowls, one each year. These will be bred pure and also crossed on the barred Plymouth Rock stock of the station. Any pure breed or hybrid showing up well will be retained and bred further.

Experiments are also planned to investigate the influence of external conditions, particularly feeding, upon egg production. At first this will be largely confined to the influence of the amount and kind of protein in the ration.

INDEPENDENT POULTRY WORK OF THE BUREAU.

On January 1, 1908, a new line of investigation was taken up in the study of the conditions surrounding the production, transportation, and marketing of eggs, with a view of determining some of the causes of deterioration in quality and consequent loss in value. With this object in mind, a careful preliminary field study of the conditions throughout the great area of the Mississippi Valley and the South has been made, and it is intended to follow this by a study of the large eastern markets. It is believed that information is being obtained which will be of much value in pointing out means for bettering the quality of the southern and western eggs shipped to the East and of saving a considerable unnecessary loss to the producers.

Mr. Milo M. Hastings, who is making these studies while working in the cold-storage rooms of some of the large Chicago cold-storage plants, observed that the instruments used for determining and regulating the moisture in these rooms were far from satisfactory. As the control of moisture is one of the most important factors in the proper cold storage of eggs, he set to work on this problem, and has devised an instrument termed a cold-storage evaporimeter, which shows automatically whether the moisture in the air is below or above the amount desired. This instrument has been tested in some of the largest cold-storage houses in Chicago and has proven satisfactory. It is not only suitable for indicating the moisture of egg rooms, but also for any location where the temperature is held constant. The Department has already made application for a patent on this device, so that the same may be used free of royalty by persons in the United States, and a description of the instrument has been prepared for publication as a circular of the Bureau.

During the past year the investigations with poultry, begun in 1906 at the quarantine station of the Bureau at Halethorp, Md., have been continued at the new location at the Bureau Experiment Station, Bethesda, Md. The present equipment consists of a laying house 16 by 80 feet, divided into five pens, with a small feed house attached; five colony houses, each 7 by 12 feet; four smaller colony houses; a laying house, 12 by 36 feet; an incubator house, with a capacity of seven 240-egg incubators; a small building used as a cook room, office, and quarters for the attendant, and a number of outdoor brooders. The area used for the poultry consists of about 5 acres, fenced with 6-foot woven-wire fencing.

The experimental work to compare the moist mash, dry mash, and hopper methods of feeding laying hens has been continued during the past year. The yearling hens are being carried through their second year by these methods, while pens of pullets hatched from these hens are being fed in the same manner to determine the effect, if any, upon vigor and vitality. It is planned to continue this investigation two or three generations further.

During the year about 20 capons have been fed in comparison with the same number of cockerels. About 30 cockerels were fed on a ration containing a small amount of cotton-seed meal in comparison with a similar lot fed with linseed meal in place of cotton-seed meal. It is planned to repeat both of these feed trials with the present growing stock.

SUPERVISION OF PEDIGREE RECORD ASSOCIATIONS.

The system of supervising pedigree record associations which went into effect July 1, 1906, continues to work smoothly and successfully. The secretaries almost without exception have adopted the form of entry certificate prescribed by the Treasury Department for the importation of purebred animals free of duty, and delays at the port of entry have been avoided. The regulations of the Secretary of Agriculture (B. A. I. Order 136) for the certification of pedigree record associations have been amended so as to render a certified American association liable to withdrawal of certification in case imported animals which are registered to obtain the duty-free privilege are not first registered by one of the foreign affiliated associations for the breed. This amendment was necessary because, owing to a misunderstanding of the intent of the regulations, a few American secretaries registered imported animals which had not first been registered in the certified foreign association for the breed. Three additional associations were certified during the fiscal year, making a total of 135, of which 70 are American and 65 foreign.

In the fall of 1907 a Bureau representative made an investigation of all the American pedigree record associations certified by the Department, and found that with few exceptions their work was being very well conducted.

The authority under which the Department acts in supervising pedigree record associations is that conferred by paragraph 437 of the tariff act of July 24, 1897 (as amended March 3, 1903), which reads as follows:

> Any animal imported by a citizen of the United States specially for breeding purposes shall be admitted free, whether intended to be so used by the importer himself or for sale for such purpose: *Provided*, That no such animal shall be admitted free unless pure bred, of a recognized breed, and duly registered in the books of record established for that breed: *And provided further*, That certificate of such record and of the pedigree of such animal shall be produced and submitted to the customs officer, duly authenticated by the proper custodian of such book of record, together with the affidavit of the owner, agent, or importer that such animal is the identical animal described in said certificate of record and pedigree: *And provided further*, That the Secretary of Agriculture shall determine and certify to the Secretary of the Treasury what are recognized breeds and purebred animals under the provisions of this paragraph. The Secretary of the Treasury may prescribe such additional regulations as may be required for the strict enforcement of this provision. Cattle, horses, sheep, or other domestic animals straying across the boundary line into any foreign country, or driven across such boundary line by the owner for temporary pasturage purposes only, together with their offspring, may be brought back to the United States within six months free of duty, under regulations to be prescribed by the Secretary of the Treasury: *And provided further*, That the provisions of this act shall apply to all such animals as have been imported and are in quarantine or otherwise in the custody of the customs or other officers of the United States at the date of the passage of this act.

The purpose of this act was primarily to protect the United States against frauds in importations, and to protect breeders of the United States against inferior animals which could be imported readily duty free unless some restrictions regarding pedigree were provided. The Treasury Department has so framed its regulations that registration in a certified American book of record is necessary in practically all cases before the importation of animals duty free for breeding purposes is permitted.

Although the operations of the law now in force have to do strictly with nothing but the importation of breeding animals, the breeders of the country have come to regard the certification of the Department of Agriculture as a safeguard and a guaranty that the association so certified is doing a legitimate business. In the public opinion the prestige gained by the Department's certification is of far more importance than any other consideration. In the States of Iowa, Minnesota, Pennsylvania, Utah, and Wisconsin legislation has been enacted which requires stallions standing for public service to be registered with the State authorities and duly licensed as purebred or grade. In determining what stallion should be licensed as purebred, registration in an American stud book certified by the Department is a prerequisite. It is also a common practice at stock shows to make a similar requirement for animals shown in the breeding classes.

That the rather close supervision which the Bureau now exercises over certified American associations has resulted beneficially there is little reason to doubt. However, it is rather anomalous that a law intended to guide customs officers in deciding what animals shall be imported free for breeding purposes should in its operation be so changed in effect that it is of much more importance to the country as a measure for the supervision of local record associations. This condition makes the administration of the law, as it relates to this Department, rather difficult. Moreover, there is nothing in the law which protects the American breeder against fraudulent registry associations. If some of the associations now certified should see fit to refuse to comply with the Department's regulations they could still continue their business, and might in time overcome the loss of prestige resulting therefrom. Furthermore, should the tariff be revised in such a way as to place a duty on breeding animals there would be no further excuse for the Department's supervision, and there would be no safeguard to the small breeder except such as might be furnished by State laws, which would result at best in a very unfortunate lack of uniformity.

At present there are several associations of considerable prominence, none of which are registering stock which is really purebred and none of which are certified, but all of which are doing business over a considerable extent of the country. They cater to the beginner, the poorly informed breeder, who usually needs protection most and can least afford to lose money on account of poor pedigree certificates. Such a man does not as a rule know what constitutes the difference between a certified and an uncertified association, yet when he buys an animal registered by one of the uncertified associations referred to, its transfer as a purebred animal is as a rule impossible. At best, registration in an uncertified association is a waste of money.

To remedy this state of affairs it is recommended that Congress be asked to enact legislation providing that no person or association of persons shall be permitted to engage in the interstate business of recording or registering pedigrees of domestic animals without having first obtained the certification of the Secretary of Agriculture, and that the Secretary of Agriculture be empowered to make and enforce such regulations as may be needed to carry out the provisions of the law. Although the mere failure to obtain or keep such certification would be sufficient to keep illegitimate associations out of interstate business, there should be ample penalties for the punishment of persons who violate the law.

THE DAIRY DIVISION.

The work of the Dairy Division, under Mr. Ed. H. Webster, chief, is organized in sections dealing, respectively, with (1) dairy farming investigations, (2) dairy products investigations, (3) dairy manufacturing investigations, (4) market milk investigations, and (5) renovated butter inspection. The specific lines of work carried on may be summarized as follows:

1. (*a*) Work in the interest of southern dairying; educational in character, conducted throughout the Southern States; intended for the development of the dairy industry in that section.

(*b*) Herd record work, comprising a study of the performance records of dairy cows, and ways and means whereby farmers may be interested in keeping such records.

(*c*) Dairy building investigations, which consist in devising plans, as simple as may be, for the construction of barns, silos, dairy houses, creameries, and cheese factories, including an extensive study of the subject of barn ventilation.

2. (*a*) Investigations in the manufacture and storage of butter, with special reference to its keeping quality.

(*b*) Investigations in the manufacture of the Swiss type of cheese; a fundamental study of the principles involved in the manufacture and curing of cheese.

(*c*) Investigations in the manufacture of the Cheddar type of cheese, supplanting the development of lactic acid by the use of mineral acids in the process of making.

(*d*) Studies in the manufacture of the Camembert, Roquefort, and other types of soft cheeses, their adaptability to American conditions, and the possibility of their manufacture in this country.

(*e*) An extended study of the problem of milk secretion, including an investigation of the effect of period of lactation, of the breed of the animal, of climatic conditions, and of different feeds, upon the quality, both physical and chemical, of the milk.

3. (*a*) Investigations in creamery methods and practice.

(*b*) Investigations in cheese factory methods and practice.

(*c*) Investigations of the principal markets where butter is sold as to market conditions, quality of butter, and causes and defects found in butter.

(*d*) Investigations into the conditions existing in cream-shipping territory—that is, where cream is shipped by rail to distant points for manufacture into butter, including such questions as the factors that affect the quality, the price received by the farmer as paid by the creamery, and a general observation of results obtained over the entire territory where such conditions exist.

4. (*a*) Investigations of the handling and distribution of milk intended for market purposes, with special reference to methods of inspection that may be adopted by boards of health or other officials.

(*b*) Investigations in regard to the farm methods necessary for the production of milk intended for market purposes, so that it will reach a good standard of wholesomeness and meet the requirements of city ordinances.

5. Inspection of renovated butter factories and markets and certification of renovated butter for export.

In addition, the Dairy Division cooperates with the officials of the National Dairy Show Association in so far as such cooperation will assist in developing the educational features of their annual show. It also sends representatives to dairy conventions, both State and National, so far as practicable, for the purposes of assisting in their work and gaining information of use in the work of the Division. Dairy literature is indexed and classified and information is disseminated by means of publications and correspondence.

It is the policy of the Dairy Division to encourage State officials to carry on work for the benefit of the dairy interests in their respective States. The Division does not wish to continue indefinitely work which the States can and should do for themselves. While it is sometimes desirable, as in the case of the southern dairy work, for the Division to begin work of an educational character and to make a study of conditions and needs, the policy is to induce the State authorities to take up and continue the work and allow the Department gradually to withdraw.

DAIRY FARMING INVESTIGATIONS.

The work of this section is in charge of Mr. B. H. Rawl.

SOUTHERN DAIRYING.

Ten men have been employed during the past year in the work for the development of dairying in the South. While it is intended that the field men should give all assistance possible to the dairymen with whom they come in contact, provided the dairymen are in a position to be assisted, still it is realized that it is best not to attempt to get a farmer to adopt too many new things at one time; hence one or two things that are most essential are taken up first, and when results have been obtained with these and the farmer's confidence won, other things are recommended. Since two of the greatest drawbacks of southern dairymen are the lack of a sufficient number of good cows and the lack of suitable buildings (barns, silos, dairy houses, etc.) for handling in the best and most economical manner the cows and their products, the greater part of the attention of the field men has been devoted to herd testing and buildings. This work has been the means of making many unprofitable dairies profitable.

HERD TESTING.—During the year this work was begun with 116 herds, containing 3,921 cows. Of these herds 43, containing 1,428 cows, were discarded before the work had been in progress very long because of the indifference of the owners, and with 84 herds, containing 2,493 cows, the work has been successfully conducted. As soon as good results are obtained the owner usually purchases a purebred bull for his herd unless he already has one; therefore practically all of the 84 herds mentioned are headed by purebred bulls.

As an example of what is being accomplished, the following table has been compiled, showing the results of twelve months' records kept of 719 cows in small herds located in various parts of the South.

Summary of records of different classes of cows based on butterfat production for one year.

Items.	Average of 719 cows.	Best cow.	Poorest cow.	Average of best 10 cows.	Average of poorest 10 cows.	Average of best 30 cows.	Average of poorest 30 cows.
Milk produced.........pounds..	4,299.4	8,325.5	1,125.0	8,681.9	1,577.6	7,326.0	2,099.6
Butterfat produced...pounds ..	216.84	538.79	64.12	459.0	77.21	391.75	100.7
Value of butterfat at 28 cents a pound..........................	$60.71	$150.86	$17.95	$128.52	$21.62	$109.69	$28.20
Value of skim milk at 20 cents a hundredweight............	$8.17	$15.57	$2.12	$16.45	$3.00	$13.87	$4.00
Total value of products..........	$68.88	$166.43	$20.07	$144.97	$24.62	$123.56	$32.20
Cost of feed per cow............	$36.27	$72.03	$23.80	$65.73	$24.63	$54.83	$27.36
Profit[a] per cow..................	$32.61	$94.40	—$3.73	$79.24	—$0.01	$68.73	$4.84
Cost of producing 1 pound butterfat ....cents..	16.7	13.4	37.1	14.3	31.9	14.0	27.2
Returns for each $1 invested in feed..........................	$1.90	$2.31	$0.84	$2.20	$1.00	$2.25	$1.18
Profit[a] on each $1 invested in feed..........................	$0.90	$1.31	—$0.16	$1.20	$0.00	$1.25	$0.18

[a] Profit as here used means simply gross returns less the cost of feed; other elements of cost are not considered.

The valuation of butterfat in the foregoing table (28 cents a pound) is based on the average price quoted in the New York market for butter for the past twelve months. Much of the product of these herds sold for a higher price, but in order to put all the cows on a comparable basis, and also that these results may be comparable with similar results from other sections of the country, this valuation is used and is considered fair.

The cost of feed consumed by the best cows was in all cases too high, showing that sufficient attention is not given to home-grown feed.

While the cost of producing a pound of butterfat is higher than it should be if the most economical methods of feeding were used, still it is only 13.4 cents a pound with the highest producing cow, while it is 37.1 cents a pound with the one that produces the least. This suggests a question that should be considered by the dairyman: How can he afford to keep cows that produce butterfat at a cost of 37.1 cents a pound which must sell at from 28 to 30 cents a pound?

Furthermore, these facts show that the idea so prevalent among southern farmers that cattle do not produce well in that section is incorrect, and that profit in that section, as elsewhere, depends on the quality of the cattle and the methods of handling them.

Another important consideration in connection with the facts above given is that the work of herd testing is done not primarily to secure this information, but in order that the owner of the cattle may be taught the enormous difference in the producing qualities of cattle, and hence improve his herd by getting rid of the inferior ones. Within two months after the testing is begun with a herd the owner usually begins to cull out the poorest cows. As the figures given in the table show only the results from animals of which a year's record was obtained, it is evident that many of the most inferior cows in the herd tested are not included in these records.

Numerous letters attesting the practical value and results of this work of herd testing have been received. A Louisiana dairyman writes:

> As a result of the facts obtained in carrying out this idea I reduced my herd 30 per cent and yet increased the production 15 per cent. The saving of feed and labor with the lesser but more profitable herd was large, reversing the business from a questionable financial venture to a decidedly profitable one.

A Georgia farmer says:

> It took nearly a year to convince us that some of our favorite cows were losing us money, but as soon as this was found out they were disposed of. The first winter we milked 20 cows most of the time and shipped an average of 100 pounds of butter per week. The second winter we milked 12 to 14 cows and shipped an average of 99 pounds per week. The difference was due to the silo, scales, and Babcock test. I thought all our cows were about the same until the record was kept and tests made.

Dairy buildings.—During the fiscal year 45 silos were built by farmers and dairymen under the supervision of the Dairy Division, and after plans furnished by it, and 112 more were proposed and in process of construction in the summer of 1908. There were also completed during the fiscal year 24 barns, and 28 were proposed for construction during the summer and fall. Five dairy houses were built and a large number remodeled.

City milk supplies.—Systematic work has been conducted in nine southern cities with the object of assisting the cities to establish such systems of inspection and control of their milk supplies as will safeguard the public against danger but will not work a hardship on the honest dairymen who are producing a safe product. Some of the cities with which this work has been done have adopted the Dairy Division score-card system and have made material advancement.

Creameries.—Assistance has also been given in organizing a few creameries. Two new creameries have been built in Texas with the advisory assistance of the Dairy Division, and some work has been done with creameries that are in operation in Tennessee and Kentucky. As a rule the dairy industry is not sufficiently developed in the South to warrant the establishment of creameries, and the Dairy Division endeavors to discourage the building and selling of creameries by promoters in communities where sufficient milk is not being produced to justify their operation.

Organization, cooperation, etc.—When the field work was begun by the Dairy Division in the Southern States there was practically no organization of the dairy interests. Recognizing the great importance of organization which would not only support the work but furnish a means of utilizing its results to the best advantage, considerable attention has been given to this subject. Some of the State organizations that were in existence prior to this work have been revived and made active. One State and several county associations have been organized, and others have been planned. The field men in every State take very active part in the work of all dairy organizations. With the development of the dairy industry it is expected that such organizations will bring about the creation of State dairy departments, and will be the means of obtaining support for the continuance and development of the very work that the Dairy Division has begun.

It is most gratifying to report that the cooperation with State institutions has, on the whole, been very satisfactory. The cooperating institutions have appreciated the value of the work, have encouraged it, and assisted in every way that their facilities would permit. They have had but little money available for such work, but they have foreseen that this field work will most assuredly establish a dairy industry in that section, and that as results increase the farmers will become interested and will provide facilities for continuing it. Because of the interest which has been created purely by the work of the Dairy Division, the North Carolina department of agriculture and the Mississippi Agricultural College have recently supplied, at their expense, assistants for this work, and it is quite probable these States will increase their support as further results are produced, and will eventually take over the entire work. Louisiana also provided an assistant for that State during the past year, and his time was largely taken up with experimental work, which is hereinafter reported. The Georgia Experiment Station has provided $600 for dairy field work in that State during 1909. Other States will doubtless follow the examples of those above mentioned. The fact that men are being appointed by State institutions to give their entire time to the work of visiting the dairymen and teaching them is a strong indication of the great and far-reaching effect of the work that the National Department of Agriculture has been conducting in that section for the past three years.

In Mississippi and Georgia publications have been issued by the experiment stations giving the results of the work done by the field men. The North Carolina department of agriculture also has one in course of preparation. These local institutions are encouraged to issue publications from time to time so that the people of the States in which the work is in progress will get the use of its results.

More than 80 agricultural meetings have been attended by the field workers during the past fiscal year. Assistance is given in conducting the short courses in dairying at the agricultural colleges in all States where such assistance is needed. In a number of States considerable work has been done in connection with State fairs, and some of the fairs are now making their dairy departments quite prominent.

Feeding experiments.—An experiment in feeding calves with blackstrap molasses, conducted in cooperation with the Louisiana Experiment Station, has been completed, and the results have been published in Bulletin 104 of that station. Since the results were entirely negative, they were considered of little value to persons outside of the section where blackstrap is produced; hence no publication on the subject was issued by the Dairy Division.

In view of the possibility of the cold-pressing process for extracting cotton-seed oil coming into use, an experiment to determine the feeding value of the cake resulting from this process as compared with the meal and hulls from the ordinary process has been conducted in cooperation with the Louisiana Experiment Station. The cold process differs from the ordinary process in that the hulls are not removed and the "meats" are not heated, the resulting cake containing both the meal and the hulls of the seed. The only reason to suppose that the cold-pressed products would differ in feed value from an equal amount of meal and hulls was that the heating in the ordinary process might affect the digestibility of the meal. The results of the experiment show that if there is any advantage in favor of the cold process it is so small as not to be worthy of consideration in ordinary operation.

HERD RECORD WORK.

Two principal lines of work now under way to promote the keeping of records of dairy herds are the establishment of an advanced register of merit for recording the performances of all purebred dairy cows on the basis of yearly records as authenticated by the officers of experiment stations, and the organization of cow-testing associations or organizations intended to encourage the farmer to keep accurate records of his dairy operations.

For the purpose of working out systems of herd testing that are best suited to various conditions, one man was appointed May 1, 1908. These systems will be applied under the supervision of the Dairy Division until they are thoroughly tested, and those that prove satisfactory will be made available to communities where testing associations are being organized. Assistance will be given in organizing herd-testing associations only in cooperation with some State institution, the object being to assist the State institution so that it may eventually continue the work independently.

DAIRY BUILDING INVESTIGATIONS.

Silo experiments.—Since the silo investigations were begun in connection with the southern dairy work it has been realized that the available data on the pressure of silage were insufficient if not unreliable. A special dynamometer for measuring silage pressure has therefore been designed and is being made. If, after testing this machine, it is found satisfactory, arrangements will be made to go into the question thoroughly during the coming year.

Two silos have been built of cement and metal in order to test that kind of construction.

Stable ventilation.—There is much difference of opinion as to the effectiveness of the different systems of barn ventilation. During the winter of 1907–8 an experiment was conducted for the purpose of making a comparison of all the principal systems so as to determine the efficiency of each. A barn for this work was provided by Mr. H. McK. Twombly, of Madison, N. J., and more than 1,700 tests were made for carbon dioxid, moisture, and temperature. Another winter at least will be required to complete this experiment. While no general conclusions can yet be drawn, the results so far obtained indicate very strongly that some of the principles of ventilation that have been accepted in the past are entirely wrong.

DAIRY PRODUCTS INVESTIGATIONS.

This work is in charge of Mr. L. A. Rogers, and a considerable part of it is carried on in cooperation with State experiment stations, because of lack of proper facilities to do the work in or near Washington.

BUTTER INVESTIGATIONS.

Fishy flavor.—The investigations to determine the cause of the so-called fishy flavor of butter have been continued. The factors ordinarily connected with this trouble have been eliminated as possible causes, but further investigation will be necessary to determine the actual cause. While acid appears to be essential to the production of this flavor, it does not seem to be the controlling factor. Certain results have indicated that the controlling factor is the treatment of the butter in the churn, but this point has not been clearly demonstrated.

Butter from sweet and sour cream.—It has been demonstrated that butter of superior keeping quality may be made from cream properly pasteurized and cooled and churned without the addition of a starter. This has been shown with butter made and stored under both experimental and commercial conditions. The difference between butter made in this way and ordinary ripened butter is especially noticeable at the higher storage temperatures.

It has also been demonstrated that the keeping quality of storage butter made from pasteurized cream is in a general way in an inverse ratio to the amount of acidity developed in the cream.

Classification and study of lactic-acid bacteria.—A study has been made of the value of cultural and other characteristics used in classifying this group of bacteria. A large number of cultures have been obtained from various sources and grouped on the basis of fermentation of sugars. The permanency and value of these groups in describing lactic-acid forming bacteria are being determined.

A number of species and varieties of bacteria capable of forming acid from milk sugar and digesting casein have been collected from various parts of the country. This group of bacteria is widely distributed and is usually very abundant in cream which has been improperly cared for. They belong to the lactic-acid group and are able to live under conditions which exclude most bacteria. The morphology, physiology, and cultural characteristics of these bacteria have been studied with a view to their proper classification, and the rate and extent of growth in competition with nonliquefying lactic-acid bacteria has been determined. The nature of the enzymes secreted and their influence on the flavor of butter has been studied. It has been found that the growth of these bacteria in cream has a deleterious effect on the quality of the butter.

Cultures for making starters for butter making.—Work has been started in investigating the possibility of making dried cultures of superior vitality by using a new process of drying milk. It has been found that partially soured milk dried by this process contained after three years sufficient bacteria to develop acidity rapidly when the necessary water was supplied. It has also been found that by properly neutralizing the acidity produced by the growth of lactic-acid bacteria a maximum number of bacteria may be obtained three or four times greater than the usual maximum reached in the ordinary souring of milk. It is hoped that by combining this principle with the special method for drying cultures a culture may be obtained at a low cost which will retain its activity for a long period and will produce a mother starter of more than the ordinary vitality.

CHEESE INVESTIGATIONS.

Cheddar experiments.—The cooperative experiments in making Cheddar cheese inaugurated two years ago by the United States Department of Agriculture and the Wisconsin Agricultural Experiment

Station at Madison, Wis., have been devoted to the problem of substituting commercial acids for the biological lactic acid developed during the process of manufacture. The first year (1906–7) was mostly given to experiments for determining the kind and amount of acid best suited for the purpose and to testing methods of manufacture applicable to the new system. During this time a method for adding acid to milk without producing coagulation was devised and several hundred cheeses were made with seven different acids. Some of these cheeses were of excellent quality, but most were deficient either in flavor or texture, the texture being more frequently at fault. The most promising results were obtained with hydrochloric and phosphoric acids, and accordingly these acids were selected for further trial.

With each of these acids great improvement has resulted in both texture and flavor, which has been maintained throughout the life of the cheese. The average scores of all cheeses made with commercial acids during February, March, and April, 1908, have been a trifle higher than the scores of control cheeses made from the same milk with a lactic-acid starter. A duplicate set of these cheeses was placed in cold storage at 34° F. immediately after being paraffined, and will be kept under conditions which conform to the best practice. This should furnish a more satisfactory test of the process than is afforded by cheeses cured at higher temperatures in the university rooms.

Owing to scarcity of milk it has been impossible to test commercial acids on a factory scale at the university, and accordingly arrangements were made for this work at a factory owned by Mr. H. J. Noyes, Muscoda, Wis. Cheese was made at this factory during two weeks in May, 2,500 pounds of milk being used daily. All of the cheeses obtained, together with check cheeses made in the ordinary manner from the same milk, were put in cold storage for comparison.

In practically all experiments there has been less fat lost in the whey and an increased yield of cheese when commercial acid was used, as compared with results of the ordinary method. The increase in yield has been from 1 to 5 per cent, and is considerably more than sufficient to pay for the acid used.

During the past winter a few pasteurized cheeses were made with the addition of commercial acid, and these proved to be of exceptionally good quality. The importance of this line of work warrants more extended experiments next year.

SOFT-CHEESE INVESTIGATIONS.—The investigations in the manufacture of the Camembert and Roquefort types of cheese have been continued at Storrs, Conn., in cooperation with the Storrs Experiment Station.

The work of the past year with regard to the Camembert type indicates that a temperature of 65° F. in the making room is warm enough to induce proper drainage. At this temperature normal souring goes on, while the development of gas is much restrained. These results agree with the best usage observed in the factories making this cheese.

In our previous work new milk was used, and such milk obtained with special care was prescribed in a published report. Experiments have been made in using milk from the ordinary farm twenty-four to thirty-six hours old, and from the college herd twelve hours, twenty-four hours, and thirty-six hours old, with and without refrigerator cooling, as well as fresh milk cooled. The present indications are that milk drawn with reasonable care and held for twelve to twenty-four hours works up as well as or better than entirely fresh milk, so long as acidity has not begun to develop to an appreciable extent when the milk is received. The unripe part of imported Camembert cheese is very sour. Such acidity seems to be more uniformly obtained in milk which has been held overnight at least. Further investigations on this point will be made.

Experiments have indicated that the temperature of the ripening room should be lower than that heretofore recommended, and that the room must be kept moist and the period extended to four or five weeks. So far results indicate that the best-flavored cheeses are obtained by the use of this longer period. Further experiments are desired to establish definitely what period and what temperature are best.

Recent work has proved the presence of yeasts in both imported and domestic cheese of the Camembert variety. There is some reason to regard these organisms as the cause of much gassy curd. This problem is so far practically untouched.

Cheeses of the Roquefort type have been made regularly and ripened in various ways with very uncertain results, which have sometimes been very encouraging, but have involved many complete failures. Experiments are being continued with a view to overcoming the difficulty encountered in producing the ideal open, crumbly texture.

In connection with the study of the molds concerned in the ripening of soft cheese, the mycologist engaged in this work, Dr. Charles Thom, has prepared an extensive technical treatise dealing with species of Penicillium.

The chemical work, carried on by Mr. Arthur W. Dox, has consisted in studies of the proteolytic products occurring in the ripened cheese and of the enzymes produced by the molds. Many of the chemical constituents of the Camembert type of cheese have been isolated and identified, and the absence of typical putrefactive products has been demonstrated. A paper entitled "Proteolytic Changes in the Ripening of Camembert Cheese" has been prepared for publication as Bulletin 109 of the Bureau of Animal Industry. As a logical sequence to the work reported in that bulletin, new investigations have been instituted to determine the chemical nature of the factors that cause the ripening of the cheese.

Swiss-cheese investigations.—This work, which is carried on at Albert Lea, Minn., in cooperation with the Minnesota Experiment Station, is in charge of Mr. C. F. Doane and Mr. T. W. Issajeff. In connection with the laboratory plant used for butter investigations at Albert Lea, there has been constructed a curing room for cheese. Space has been secured in the creamery plant for the manufacture of the Swiss type of cheese, and milk is purchased from the Albert Lea Dairy Association for this purpose.

The fundamental problems involved in the manufacture of Swiss cheese are but little understood; the whole process seems to be one of "rule of thumb" rather than any scientific method. Makers of the Swiss type of cheese in this country, as well as in Europe, follow the plan which has been in vogue for a great many years in Switzerland

and Germany. This method is open to many objections, as it is almost impossible to get a uniform product with any degree of certainty, and the losses sustained in the making through the loss of butterfat in the whey are enormous. The physical and biochemic theories of ripening have not been studied to any extent in this country or abroad. This is a large and important field of investigation. The facilities for this work at Albert Lea have been materially improved and enlarged during the past year, and good progress has been made in determining some of the fundamental problems.

MILK SECRETION INVESTIGATIONS.

The investigations to determine various facts regarding the process of milk secretion and the changes in the composition of milk because of different conditions of breed, feed, lactation period, etc., have been continued in cooperation with the Missouri Experiment Station. Several years will be required for carrying out these investigations, and certain preliminary studies have been found necessary before attacking the main problems. A report of some of this preliminary work, in the nature of a chemical and physical study of the large and small fat globules in cows' milk, by R. H. Shaw and C. H. Eckles, has been prepared for publication as Bulletin 111 of the Bureau. During the fiscal year the effect of the period of lactation on the composition and properties of milk has been studied. It is proposed to take up next the effect of certain feeds, particularly cotton-seed meal, on the milk. These investigations involve a vast amount of tedious routine work, including an immense number of chemical analyses.

MARKET MILK INVESTIGATIONS.

The work of this section during the past year, in charge of Mr. C. B. Lane, assistant chief of the Dairy Division, has been largely along educational lines, such as giving assistance to city boards of health and to dairy farmers, by personal visits, public lectures, and milk contests; in fact, a general campaign has been conducted for the improvement of market milk and the development of the dairy interests of the country.

Mr. Lane and his assistants personally visited 125 cities during the year, usually at the request of the health officers for assistance in improving the milk supply. The general plan has been for a representative of the Division to visit a city, consult with the health officer and in some instances with the board of health and the city council jointly, and discuss the milk ordinances in force and suggest improvements; to advertise in the local papers a general public meeting for dairymen, consumers, and physicians, and at such meeting to discuss the milk question in a comprehensive way. The score-card system is explained and general information is given as may be needed. Special meetings are frequently held with dairymen and physicians to discuss dairy matters from their particular standpoints. One or more days are usually spent with the city inspector in personally visiting and scoring dairies with him and giving him all the assistance possible in introducing the scoring system. The Dairy Division score card, or a slight modification of it, has been adopted or used by city or State officials, creameries, dealers, etc., in 61 cities, while 79 other cities have been given assistance through correspondence or visits by the inspectors, making a total of 140 cities, located in 24 States, the District of Columbia, and Canada, that have been given more or less assistance during the year. A number of cities have made marked improvement in the condition of the dairies supplying milk; for example, one increased the average score of the dairies from 41.5 to 72 points in a year.

In connection with this work of improving the milk supply, representatives of the Dairy Division have attended and taken part in 82 public meetings held in 55 cities in 24 States. The Division has also assisted materially in holding five milk contests.

No attempt has been made to visit all of the dairy farms supplying milk to any city. However, 206 dairies with 527 cows have been inspected by members of the Dairy Division staff in connection with the work of improving the milk supply of cities. These were located in 50 cities and towns in 16 States. The average score of these dairies was 51.05 on a scale of 100. The average score for equipment was 60.28 and for methods 46.04. This indicates very clearly that it is not so much better equipment that is needed as better methods. The average rating of 1,000 dairies inspected in Maryland, Virginia, and the District of Columbia during the past two years was 45.41.

Reports have been received on about 10,000 dairies that were rated by officials and persons outside of the Dairy Division by the use of the score card, and the average score of these dairies was about 52.5.

In the spring of 1908 an inspector was assigned to a special investigation relative to the best methods of producing and handling milk on dairy farms.

One man spent six months at the Jamestown Exposition demonstrating methods of handling milk.

DAIRY MANUFACTURES.

The work of the section of dairy manufactures, which is in charge of Mr. B. D. White, relates to the business operations of butter and cheese factories and the commercial problems of manufacture and distribution. Branch offices are maintained at New York City, Chicago, and San Francisco, with experts in these subjects in charge. These officers carry on correspondence with butter makers, creamery superintendents, and creamery managers in regard to the commercial quality of butter received in these respective markets. They examine this butter either on request from the creamery shipping it or on request of the buyer. In either case the inspector goes to the store when the butter is received, takes samples for analysis, examines it for defects in quality, and reports his findings, with the analysis, to the creamery, the purchaser, the dairy and food department of the State where the creamery is located, and to the Washington office of the Dairy Division.

The New York office during the year made 700 inspections, and since the beginning of this work has examined the product of 360 creameries. Regular inspections are being made for about one-third of the butter commission firms in New York City and occasional inspections for other firms. The Chicago office inspected 1,230 lots of butter and has examined the product of 877 creameries since this work was undertaken, 352 new creameries having been added to the list during the fiscal year.

This work is undoubtedly of much practical value to the creameries and dealers, and it is growing in favor with those interests. The principal objects are to improve the quality of butter and to assist creameries in overcoming conditions causing poor quality.

There seems to be more of a disposition on the part of the creameries in general to consider the inspector's suggestions in the light of their possible helpfulness in improving the quality of their butter rather than to regard them as critical fault-finding. As the creameries have become more familiar with the work they have come to understand that the inspection of their butter is both a help and a protection, and are accordingly showing much more interest in it. As the butter dealers have found that the creameries are willing to accept the inspectors' reports in the proper spirit they have made more use of the inspection.

While there are many creameries that have been helped to improve the quality of their butter, there are many others which have made no improvement because the character of the cream which they were receiving was such that it was impossible for them to make a better grade of butter. A close study of the butter as it comes to the market shows plainly that the average quality is poorer than in past years. This is due largely to the way the cream is handled on the farm and the length of time it is held. With the introduction of the hand separator the farmer has found that he can keep the cream longer on the farm and take less care of it, and still find a market for it, and he has taken advantage of this to the limit. At first the local creameries refused to take this poor cream, but they soon found that if they did not take it the so-called centralizer creameries would. Many creamery managers say they know they are taking cream which is unfit for butter making, but that they are forced to do this by the competition of the centralizers. A few creameries that have been able to hold their patrons and force the delivery of fresh cream have, with the aid of improved machinery and methods, made a better and more uniform quality of butter. Many of the creameries handling this poor cream are using pasteurizers and other up-to-date machinery, but the quality of their cream is so poor that the improved methods do not make any appreciable improvement in the quality of their product.

Moisture is another factor which has much to do with the quality of butter. As competition becomes stronger and many of the creameries are unable to improve the quality of their butter, they are trying to make a gain by incorporating moisture up to the limit allowed by law. Unfortunately, very few butter makers are posted on the proper methods of incorporating moisture. Many are using methods which are very seriously injuring the texture, and consequently lowering the quality of their butter.

For some time past there has been too little difference in market prices for various grades of butter. During the summer there was a difference of only 4 or 5 cents a pound between the fancy grades and butter that was so poor as to be unfit for table use. The large amount of poor butter which is being made is having a very injurious effect on the butter market. Consumers may be forced to eat a butter which is not strictly first class, but it is a hard matter to get them to use the extremely poor butter with which the market is flooded. It is believed that if present conditions continue they will result in consumers gradually using less butter and eventually turning to butter substitutes. It therefore seems to be essential, if the butter business is to be maintained on a firm foundation, that the creamery men and the dairymen should realize this danger and raise the standard of their product. While the market inspection can do much toward improving quality, this alone is not sufficient. There should also be an inspection of materials used before they are made into butter, with a view not only to raising the quality of the product, but to protecting the public against unwholesome butter.

The Dairy Division has continued its work of obtaining reports from creameries and giving them assistance in their business methods, methods of manufacture, and the keeping of records. Each month there has been sent out to the creameries of the country a circular letter containing some specific and pertinent statement or suggestion, and with this letter there has been inclosed a special form for reporting the month's operations. During the year reports were received from 2,016 different creameries, the reports averaging about 600 or 800 to the month. Much valuable information is gathered from these monthly reports as to the amount of milk and cream received from the creamery patrons, the price paid, the amount of butter sold, the overrun obtained, the expense of operating the business, etc.; and this information is used in preparing the monthly letters giving advice to the creameries.

The creameries settle with the farmers on the basis of butterfat contained in the cream. The quantity of butter exceeds the amount of butterfat in the cream because of the incorporation with the butter of water, casein, salt, etc. This excess is termed "overrun" and normally amounts to 18½ per cent. When a creamery fails to show an overrun to this extent it indicates that there is some waste in the methods of manufacture or some fault in keeping the records, and in either case there is a loss to the business. The Dairy Division endeavors to point out to the creameries the fact that they are losing money when this appears from their reports, and to suggest means of overcoming the loss. This work was carried on during the fiscal year 1907 in Minnesota, Iowa, and Wisconsin, and, beginning with June, 1907, was extended to many other States. Comparison of the results for the two years in the three States named shows that the average overrun of the creameries has been raised until it more nearly approaches the normal, with a resulting financial gain estimated at $130,000 for the second year, an amount which exceeds the total expenses of the Dairy Division for the year.

During the year there have been sent out through this section plans for 23 creameries, 7 milk plants, 23 milk houses, 15 ice houses, 18 septic tanks, and 3 moisture test outfits, making a total of 89 plans for which complete specifications were drawn.

RENOVATED BUTTER INSPECTION.

The inspection of renovated butter and of the factories producing the same has been continued in accordance with the act of Congress of May 9, 1902. This work is in charge of Maj. M. W. Lang.

During the fiscal year there were 46 renovated butter factories bonded and which paid the Government tax. This is a decrease of 3 as compared with the previous year. A few of these factories were in operation only a part of the year. The output of these 46 factories during the year amounted to 50,658,159 pounds, being a decrease of 12,261,840 pounds from the previous year. There were inspected for export during the fiscal year 24,121 packages, containing 1,271,610 pounds of renovated butter, this being a decrease of 4,266,860 pounds.

During the year 190 inspections were made of the factories by representatives of the Dairy Division. Two hundred and fifty-seven samples of renovated butter were analyzed for moisture, and 34 showed a water content of 16 per cent or more. An effort is made to keep the product of inspected factories within the legal limit of 16 per cent of moisture, and in several cases where excessive moisture has been found the facts have been reported to the Treasury Department for prosecution.

WORK FOR THE COMING YEAR.

There are several directions in which the work of the Dairy Division could be extended with great practical benefit to the dairy interests of the country. Statistics show that the average yield of butterfat per cow is less than 145 pounds, or barely enough to pay the cost of feed. It has been demonstrated by dairymen in every part of the country that from 250 to 300 pounds a year are easily obtainable if proper care is used in the selection and breeding of dairy stock. While these facts are known, there has not as yet been worked out a system to make the improvement operative. The possibilities of improvement in this respect are enormous. By doubling the average yield of the 20,000,000 dairy cows in the country, at 20 cents a pound for butterfat, an additional annual gross income would be received by the American farmer amounting to $680,000,000, without increasing the number of animals. There is probably no other farm crop which by such simple means can be made to double itself in a decade. In view of the great possibilities it seems important that the Department should work out a practical plan for increasing the yield of butterfat and should carry out a campaign of education which would lead the farmers of the country to adopt measures which would bring about the desired results. This work, however, as well as other work proposed, can not be undertaken without an increase in appropriation.

Field work such as is being done in the South is greatly needed in some of the Northern and Western States. Work of this kind should be continued until the States take it up and carry it on independently. So far the results indicate that this work, if properly carried on, will eventually be the means of establishing such educational work in the different States on a basis independent of the United States Department of Agriculture. An experiment to determine the best methods of manufacturing and handling farm dairy butter under southern conditions should be begun as soon as practicable, and such investigations should also perhaps be carried on in some of the Western States. The market inspection of butter could be extended to other cities with great advantage. As yet very little has been done for the cheese industry, and the needs are about as great as in the butter business. There is also a field for studying condensed milk and other milk products.

The production of wholesome milk and the improvement of the milk supplies of cities are subjects requiring more attention and a greater force. Requests for assistance from health officers and others are so numerous that the Dairy Division can do only a small part of the work that should be done in these lines. There are also many problems connected with the dairy industry which require investigations and scientific research and which have a very practical bearing on the future progress and welfare of the industry.

REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., September 30, 1908.

SIR: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1908.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

GENERAL WORK OF THE YEAR.

The appropriations of the Bureau of Plant Industry for the fiscal year ended June 30, 1908, amounted to $1,202,230, of which $189,450 was for statutory salaries, $584,780 for the general expenses, $40,000 for grain standardization, $238,000 for the seed work, and $150,000 for the special purpose of meeting the ravages of the cotton boll weevil.

BUSINESS OPERATIONS.

The Bureau has received and answered during the past fiscal year about 300,000 letters, covering a wide range of subjects. This number does not include routine correspondence, such as requests for publications, seeds, nitrogen-fixing bacteria, etc., which is answered by means of general circular letters or pamphlets. In the work on supplies and accounts nearly 6,000 requisitions were issued during the year; 12,000 accounts were received, audited, and paid; 225 requests for contracts and leases were made; 7,000 letters of authorization and amendments were drawn; and more than 2,000 letters of instruction for field men were prepared. The system of accounting outlined in previous reports has been followed with satisfactory results, more than 90 per cent of all accounts being audited on the date of their receipt. In connection with the sending out of typewritten circulars by various offices of the Bureau, a modern duplicating device was installed on December 10, 1907, and in the six months following one operator set up and ran off 95,348 copies of circulars, letters, and reports, thereby effecting a considerable saving in the time and labor of the typewriting force.

From September 1, 1907, to August 31, 1908, the following changes have been made in the personnel of the Bureau: Resignations, 87; deaths, 6; dismissals, 7; transfers from the Bureau, 36; and furloughs and terminations of appointments, 433; making a total of 569 employees dropped from the rolls during that period. During the same period there have been made 778 appointments, increasing the total force of the Bureau by 209. On September 1, 1908, the numerical strength of the Bureau was as follows: In Washington, 515; outside of Washington, 471; total, 986. The total number of employees in the Bureau on the same date a year ago was 777.

PUBLICATIONS.

The handling of the publication work of the Bureau has continued, as in previous years, in charge of Mr. J. E. Rockwell, Editor. The new publications of the Bureau issued during the past fiscal year number 103, an increase of 42, or nearly 69 per cent, over the preceding year. These documents aggregated 2,780 printed pages and were illustrated with 166 full-page plates and 287 text figures. The number of printed pages is 45 per cent in excess of the total number during the year preceding. Of the 103 new publications, 41 were bulletins or parts of bulletins in the special Bureau series; 16 were contributed to the Department series of Farmers' Bulletins; 9 were issued as articles in the Yearbook of the Department for 1907 and afterwards printed in separate form; 10 were published in the new series of Bureau circulars inaugurated during the year, while the remainder comprised the Annual Report of the Chief of the Bureau and various miscellaneous publications. Of a total of 26 Farmers' Bulletins issued during the year by the entire Department, 16, as stated above, or more than 60 per cent, were contributed by the Bureau of Plant Industry. Forty publications of the Bureau were reprinted during the year in accordance with the provisions of General Order 96, this number being exclusive of Farmers' Bulletins originating in the Bureau which were reprinted by the Department from time to time as required, the total editions of such bulletins being approximately two and one-quarter million copies.

The Office of the Editor has been charged during the year with the performance of a large amount of miscellaneous work connected with the issuance and distribution of the Bureau publications. The preparation of indexes to publications and the recording and proof reading of 1,511 jobs of miscellaneous printing for the various offices of the Bureau have required much time.

REMOVAL OF THE BUREAU INTO NEW QUARTERS.

By direction of the honorable Secretary, the west wing of the new Department building was assigned to the use of the Bureau of Plant Industry, and on March 1, 1908, the building being ready for occupancy, the work of removal was begun. All of the offices of the Bureau occupying rented buildings, with but one exception, were brought into the new building, although considerable overcrowding was necessary. The continued growth of the Bureau renders imperative the securing of additional floor space for laboratory and office purposes.

ORGANIZATION AND POLICY.

The bringing together of the various offices of the Bureau under one roof has served to further strengthen its business and scientific organization. All of the purely administrative offices are now together, and their working efficiency has been greatly increased and facilitated. The pathological laboratories are all located in adjoining rooms, and various other offices of the Bureau which maintain close cooperative relations have been brought together. The advantages of these arrangements over separate quarters are obvious.

No great change in the organization of the scientific investigations of the Bureau has been made during the past year, but several minor changes tending to its increased effectiveness have been made. The Farmers' Cooperative Demonstration Work, formerly conducted from headquarters at Lake Charles, La., is now carried on from a central office established during the year in Washington, D. C., being in charge of Dr. S. A. Knapp, Special Agent, as heretofore, who reports directly to the Chief of the Bureau. In the Bionomic Investigations of Tropical and Subtropical Plants, the work has been concentrated on the major projects having to do with the introduction and acclimatization of weevil-resistant varieties of cotton and new types of corn from tropical countries; and in the Soil Bacteriology and Water Purification Investigations the work on water purification has been confined to farm water supplies, in accordance with an understanding reached with the Water Resources Branch of the U. S. Geological Survey. The work of the Vegetable Testing Gardens, formerly conducted in connection with the seed distribution, has been transferred to the Office of the Horticulturist of the Bureau and closely affiliated with the other work of the Bureau on truck crops. Similarly, the Fiber Investigations of the Bureau have been transferred from the Office of Taxonomic Investigations to that of Crop Technology, and future work will be along the lines of the improvement of technological practices connected with the handling of fiber crops.

The field organization of the Bureau has been further strengthened during the year by the establishment of several new stations. Among these may be mentioned the cooperative seed-testing laboratory recently opened at Lincoln, Nebr., in cooperation with the Nebraska Agricultural Experiment Station, in order to facilitate the Bureau's propaganda work in the interest of good seed for the farmer. It is planned to locate similar cooperative laboratories at other important points. In the work of Grain Standardization, several additional field laboratories have been established, notably one at Chicago, where excellent facilities are afforded for the study of conditions connected with the grain trade generally. This laboratory has the hearty cooperation of the Chicago Board of Trade. The South Texas Garden, at Brownsville, mentioned in the last report, is developing rapidly, and a résumé of its work during the past year will be found elsewhere in this report.

EXTENSION OF COOPERATIVE RELATIONS.

The Bureau has actively continued and encouraged the cooperative policy mentioned in previous reports. In nearly all of its work close cooperative relations are maintained with the State agricultural experiment stations and other State authorities, public and private organizations, and individuals, as well as with other Departments of the Government, with the other Bureaus of the Department of Agriculture, and also between the various offices of the Bureau of Plant Industry.

Notable progress has been made during the year in the development of a plan of cooperation with the Office of Indian Affairs of the Department of the Interior whereby the Bureau of Plant Industry will conduct demonstration work on the Indian reservations with a view to the education of Indian labor in the growing and handling of crops. The Office of Indian Affairs is furnishing the Bureau with every aid within its power, and already a very successful demonstration farm has been established on the Pima Indian Reservation at Sacaton, Ariz. Further mention of this work will be found further on in this report.

Mention should also be made of the increased amount of cooperative work undertaken with the Forest Service. The cooperative relations with that Bureau, referred to in the last report, have proved very effective, these including the investigations of forest diseases, the study of stock-poisoning plants in the National Forests, and the investigation of forest-grazing problems. In addition to this work, cooperative investigations have recently been planned looking to the securing of additional sources for the manufacture of paper, in accordance with recent legislation.

Within the Bureau many cooperative lines of work are under way which are handled by two or more offices. A leading feature of this work is the investigation of the problems connected with dry-land agriculture, on which no less than 10 of the 30 offices of the Bureau are working in close cooperation. Each of these offices is charged with one or more important phases of the work, such as dry-land cereals, dry-land fruits, plant breeding, moisture conservation, etc. In addition, cooperation in this work is under way with the Bureaus of Soils and Chemistry, with the United States Reclamation Service, and also with the Forest Service and with most of the State agricultural experiment stations in the Great Plains area of the West.

An increased amount of cooperative work with individual farmers has been effected, especially in the work on forage crops and in the southern demonstration work. A plan of securing through Congressmen the names of reliable cooperators has been adopted in connection with the propaganda work on forage crops, with very satisfactory results in a majority of cases.

SPECIAL INVESTIGATIONS AND EXPLORATIONS.

In accordance with a paragraph contained in the agricultural appropriation bill for the fiscal year 1909, the Bureau has inaugurated investigations having for their object the establishment of standards for the different grades of cotton entering into the trade. This work has been placed in charge of Dr. N. A. Cobb and Prof. R. L. Bennett. The latter has for several years been engaged in the breeding of cottons and is thoroughly conversant with cotton conditions in the South. During the progress of the work the services of cotton experts will be secured to aid in the establishment of correct standard grades. Studies are also being made of the handling and baling of cotton, with a view to the improvement of the methods now in vogue, which result in great losses annually. All of this work is of a preliminary nature, however, and active work will be undertaken when the present season's cotton crop is being moved.

The last session of Congress granted a special increase in the fund for the work of introducing new and rare seeds and plants from foreign countries, for the purpose of conducting another agricultural exploration of northern Siberia with a view to securing hardy seeds and plants adapted to the conditions of extreme cold in the northwestern United States. Prof. N. E. Hansen, of the South Dakota Agricultural Experiment Station, who conducted the Department's two previous explorations in Siberia, has been sent on a third mission to that region. Professor Hansen hopes particularly to be able to secure additional seed of the new hardy Siberian alfalfa which he brought back on his last exploration two years ago, as well as valuable new varieties of other hardy forage plants and fruits.

FIELD AND LABORATORY WORK IN PATHOLOGY AND BACTERIOLOGY.

The Bureau's work on plant diseases has progressed along essentially the same lines as in previous years. The work in soil bacteriology and water purification, which is closely related to the pathological investigations and for this reason may be grouped with them, has also been continued with good results. A brief summary of the work of the past fiscal year in these lines follows.

LABORATORY OF PLANT PATHOLOGY.

The work of the central pathological laboratory has been conducted, as in previous years, under the immediate direction of Dr. Erwin F. Smith, Pathologist in Charge. In addition to the regular routine work of the laboratory, such as the identification of diseased specimens, a number of special studies of various bacterial and other diseases have been made.

Laboratory studies of crown-gall.—Studies of the crown-gall diseases of various plants have been continued by the pathologists. The organism causing this disease (*Bacterium tumefaciens* Smith and Townsend) has been found to have very simple, generalized habits of life. It is able to attack a surprisingly large number of plants, pure cultures of it having been successfully inoculated into plants of 12 different families. Probably all of the common crown-galls of orchard fruits and of other cultivated plants are due to it or to closely related forms. Farmers have been advised against planting trees infected with crown-galls, since they are not likely to make durable orchards, and, moreover, will distribute infection where it does not now exist.

Rice diseases.—Experiments with reference to the control of the disease known as "rice blast" have been continued by Dr. Haven Metcalf, Pathologist in Charge of the Laboratory of Forest Pathology. A test is being conducted with a large number of varieties of rice for the purpose of finding, if possible, varieties resistant to the attacks of the fungus causing the disease. This work will be continued and an investigation will be made of the "brusone" disease of rice in Italy, and if it is found identical with the rice blast, resistant varieties will be imported from Italy. Methods for the control of the disease in Europe will at the same time be introduced into this country.

Economic collections of pathological material.—The mycological and related work has continued in charge of Mrs. Flora W. Patterson, Mycologist. With the increase of the pathological work of the Bureau, the necessity of maintaining and increasing these collections is extremely urgent. Additions of American species have been made by the preservation of material sent in for examination by correspondents, members of the Bureau force, experiment station workers, and others. Many foreign species have also been acquired through plant introduction and other work. These collections are primarily of importance for reference in connection with all of the pathological work of the Bureau. In addition to the work connected with these collections, inspections have been made of all material received or sent out by the Office of Seed and Plant Introduction, and also of the plants in the Department greenhouses. Many specimens have accrued to the collections in this manner, and the danger of introducing or spreading diseases has been materially lessened.

DISEASES OF COTTON, TRUCK CROPS, AND RELATED PLANTS.

The investigations of various diseases of cotton, vegetables, and other plants have continued, as heretofore, in charge of Mr. W. A. Orton, Pathologist. The investigation of cotton root-rot, now nearing completion, has been conducted by Dr. C. L. Shear, of the Office of Fruit Disease Investigations. The progress made in these lines of work is briefly set forth in the following:

Cotton diseases.—In the work on wilt-resistant cotton, two strains of Upland cotton which have been bred to resist wilt were distributed and are replacing other varieties in the infected districts. The only failures have come from complications with root-knot, which can be avoided by a suitable rotation of crops. A Farmers' Bulletin treating this subject has been issued. New breeding work has been undertaken to modify these varieties for the changed requirements anticipated when the boll weevil reaches the eastern part of the South, when quick-fruiting, large-bolled sorts will be in demand. Experiments with anthracnose and other diseases of cotton are in progress in the field and laboratory with promising results, but are yet unfinished.

The work in combating the Texas root-rot of cotton has been continued, and further trial of deep fall plowing and thorough aeration of the soil has given very satisfactory results. Laboratory investigations of the fungus producing the root-rot have also been continued and it is hoped to finish the work on this disease the coming year.

Cowpea diseases.—Studies of several cowpea diseases have been continued and the breeding work has been pushed with the aim of securing improvements on the Iron variety. The indications are that we have succeeded in producing new strains resistant to root-knot and more productive than Iron. Our stock of these varieties is now being increased with a view to more extended tests.

Wilt-resistant watermelons.—A test of the new wilt-resistant melons on a larger scale has shown them to possess nearly complete resistance to wilt in South Carolina and to be well fixed and of good quality. This stock is now being increased with a view to trials in other sections next year and to secure seed for distribution. A second strain, similar to the first but several days earlier, will probably be ready after another year's trial. Satisfactory progress has been made in the breeding work in North Carolina.

DISEASE RESISTANCE IN POTATOES.—Extended variety studies have been continued to compare the disease resistance of European with that of American varieties of potatoes and to learn the commercial qualities of the former. This work has been done mainly at the Vermont Agricultural Experiment Station, with auxiliary trials in Colorado, Virginia, and Oregon. Marked disease resistance was developed by several varieties, which, however, did not always possess desirable market qualities. The indications are that several Scotch varieties will prove of better quality than our own, and more productive under intensive tillage. Crosses are now being made between disease-resistant sorts and productive varieties of high quality.

The studies of Dr. L. R. Jones, of the Vermont station, a collaborator of this Bureau, have resulted in the discovery of a new culture medium which promises to throw light on the spore formation of the late-blight fungus, hitherto an unsolved problem in its life history. The season of 1907, like that of 1906, was too dry to develop an epidemic of late blight, and it therefore became necessary to continue the trials another year.

NUTRITION DISEASES OF TRUCK CROPS.—Our field studies have shown that truck growers in the older sections of the Atlantic coast region suffer heavy losses from pathological conditions in their cabbage, potatoes, spinach, beans, and cucumbers which appear to result from the continued use of excessive amounts of commercial fertilizers. Experiments under way indicate that by a modification of the formulas used, coupled with the rational use of lime, manure, and cover crops, these diseases may be prevented and large sums of money saved. Some very complicated problems in plant nutrition will have to be worked out in this connection, and field experiments will be conducted to show the connection between the diseases mentioned and the fertilizers used.

SPRAYING FOR TRUCK-CROP DISEASES.—Heavy losses are reported each year from cucumber downy mildew, cantaloupe leaf-blight, potato blights, tomato leaf-blight, and other troubles that are preventable by spraying with Bordeaux mixture. Growers fail to save their crops through lack of knowledge of the correct remedy, lack of thoroughness in spraying, or through the use of inefficient apparatus. Our experience shows that it is desirable for the Department to take up these problems in each principal trucking region, solve the difficulties, adapt the remedial measures to the local farm practice, and conduct practical demonstrations. Such work was done the past season at Norfolk, Va., in cooperation with the Virginia Truck Experiment Station, with the result that downy mildew and leaf-blight were checked on both cucumbers and cantaloupes, the value of the crop being increased $50 per acre at an expense of $5. Spraying will be more general in this section next year.

MISCELLANEOUS PLANT DISEASES.—Several troubles affecting the cabbage, bean, pea, carrot, radish, and other truck crops are under investigation, and field experiments with remedial measures are under way on a small scale. The diseases of the garden pea require study, with special reference to securing a source of seed free from fungus infection.

Progress in our work on pecan diseases has been slow on account of the pressure of other work. There is need for a specialist to devote his entire time to the diseases of the pecan. The scab and rosette, in particular, threaten to become of economic importance, being already widely distributed.

Plant disease survey.—A large amount of data concerning the geographical distribution and annual prevalence of plant diseases is being brought together by means of the plant disease survey. In addition to the usual Yearbook summary, a larger publication is in preparation. This information is utilized by many people. Data concerning foreign diseases are now being collected, which will be especially valuable should National quarantine be considered.

INVESTIGATIONS OF DISEASES OF FRUITS.

The work on fruit diseases has continued, as in previous years, in charge of Mr. M. B. Waite, Pathologist, with Mr. W. M. Scott in immediate charge of spraying demonstrations and Dr. C. L. Shear in charge of investigations of diseases of small fruits. The usual amount of investigational work, together with practical demonstrations of methods of combating fruit diseases and lectures before fruit growers, horticultural societies, and farmers' meetings, has been carried on during the past year. On the Pacific coast orchard diseases have been slightly less prevalent than in the past three years. This is also true of some special sections of the Eastern States. In the Middle West, the Lake States, and in the peach sections of the Atlantic seaboard, the diseases have been even more destructive than usual.

Pear-blight.—In California the Bureau has continued to give expert assistance to the pear growers in methods of eradicating blight. Partly through good work in eradication and partly through a favorable season the success of the treatment has been very pronounced. The California growers and the State and county horticultural commissioners are becoming more and more convinced of the practicability of combating the disease through the methods advocated by the Department of Agriculture. Although many orchards had been lost up to the season of 1907, there were relatively few trees lost through the attacks of the season of 1908. This, together with a good pear crop, has given considerable encouragement to the future of the California pear industry. On the other hand, the disease during the past year or two has invaded the fine pear orchards of the Rogue River Valley in Oregon, and the pathologists of the Bureau were called there to assist in the effort to stamp out or control the disease. Field demonstrations and lectures were also given and methods of inspection carefully demonstrated to leading orchardists. They are taking up the work with a great deal of enthusiasm and are putting into practice the eradication methods with considerable thoroughness. There is every promise that these exceedingly profitable and promising pear orchards may be saved.

Little-peach and peach yellows.—Investigation has been continued to some extent on these diseases, but the main work has been the demonstration of the methods of controlling them by eradication.

Eradication tests in cooperation with the New York (Cornell) Agricultural Experiment Station were continued in the Youngstown district of Niagara County. An unusual outbreak of yellows occurred in the peach districts from Connecticut to Tennessee. This is the most severe outbreak of this disease for thirty years and has devastated the orchards east of the Allegheny Mountains, except at the southern end of the range. In some sections 50 per cent of the commercial orchards of bearing age have been destroyed within the last three years and many individual orchards completely destroyed.

MISCELLANEOUS ORCHARD DISEASES.—Various orchard problems have been investigated from time to time during the past year. A remarkable case of winter injury was investigated in New York State, where it was somewhat confused with yellows. It turned out to be an unusually severe case of root winterkilling. Work on the gumming fungus of the peach and other stone fruits has been continued. The treatment for this disease as worked out and recommended by the Department has become general in California. The disease was found in southern Oregon to be devastating the orchards there and demonstrations have been begun in that State. Some further investigations are still required on the apricot, almond, and perhaps other stone fruits.

SELF-BOILED LIME-SULPHUR WASH.—The most important step in recent years in the use of fungicides for spraying plants was the discovery made during the season of 1907 by Mr. W. M. Scott that the self-boiled lime-sulphur wash was not injurious to peach foliage and when properly made would not produce the russeting and other injurious effects on apples. Furthermore, it was found to be about as effective as a fungicide as the standard Bordeaux mixture, perhaps more so in some cases. Extensive experiments have been carried on during the present year on nearly all our common fruit diseases which are preventable by spraying. The results have been corroborated and extended, bringing out the value of this splendid spray mixture and demonstrating its usefulness. In Georgia some slight modifications were found to be necessary this year as the result of the new season's work in the preparation of the spray. A circular was issued last winter placing this mixture at the service of fruit growers.

The prevention of russeting of apples and peach foliage injury caused by the use of Bordeaux mixture still remains an unsolved problem. However, the matter will probably be given little attention in the next couple of years, as for the present a way of avoiding it has opened up in the use of the sulphur sprays.

SPRAYING DEMONSTRATIONS.—In addition to the investigational work with the lime-sulphur mixture, Mr. Scott and three assistants have carried on demonstrations in the treatment of orchard diseases in Missouri, Arkansas, Kansas, Nebraska, Illinois, and Georgia. Where this work has been done there has resulted a very large increase in the amount of spraying. Power machines and spraying outfits of various kinds have been sold in large numbers and put to intelligent use in the orchards, to the vast improvement of the industry and condition of the orchards in those sections. The principal diseases with which these investigations and demonstrations were carried on were the brown-rot of the peach and plum, the scab, bitter-rot, blotch, and leaf-blight of the apple, and the leaf-blight of the cherry.

EXPERIMENTS WITH CROWN-GALL.—The experiments in the field study of the crown-gall and hairy-root of the apple and the crown-gall of the grape, by Dr. George G. Hedgcock, of the Laboratory of Forest Pathology, have been continued and further data collected on the effect of these diseases upon the hosts. A report has been published giving the results of the cross-infection of fruit trees and shrubs with crown-gall, also a circular of information on the stem tumors of the apple and quince, a form of the hairy-root. Further reports are in preparation, and the work of field experimentation will be continued in cooperation with Drs. Erwin F. Smith and C. O. Townsend, of this Bureau, who have discovered the cause of the crown-gall, as described elsewhere in this report.

GRAPE DISEASES.—The investigation of grape diseases has been continued by Dr. C. L. Shear and his assistants in New York, Pennsylvania, and Michigan, and work has also been commenced in New Jersey. The results of last season's efforts to control black-rot and other diseases by spraying were very successful. In Michigan, where very serious losses had been sustained for several years and little effort had been made to control the rot, the results were not quite so satisfactory the first season as they were this season. The grape growers have taken much interest in the work, and as a result about 200 spraying outfits have been purchased and used with very satisfactory results by the growers the past season. The so-called "dead-arm," which has been under investigation for several years in Pennsylvania and western New York, appears to be controllable by proper methods of pruning and spraying. Work on the life history of the fungus producing the disease is progressing. This disease has been found to cause considerable loss in Ohio and Michigan and has also been found in New York and Virginia.

MISCELLANEOUS DISEASES OF SMALL FRUITS.—The work on cranberry diseases has been practically completed so far as New Jersey is concerned. Special study is now being given to certain new diseases of that fruit which are proving destructive in Massachusetts and, particularly, in Wisconsin. The disease of the strawberry known as blackroot, which is very troublesome in Michigan and which appears to be due to a fungus, is being investigated. The study of the life histories of the various closely related anthracnoses of fruits and other plants and their relations to each other has been continued. The perfect fruiting conditions of forms from several additional hosts have been secured and cross-inoculation experiments have been carried out.

LABORATORY OF FOREST PATHOLOGY.

The investigation of the diseases of forest, shade, and ornamental trees and shrubs is in charge of Dr. Haven Metcalf, Pathologist, with Drs. George G. Hedgcock and Perley Spaulding charged with the investigation of definite groups of problems. The work is conducted in close cooperation with the Forest Service. Especial attention has been given during the past fiscal year to white pine blight, to the damping-off disease of coniferous seedlings, and to the chestnut bark disease.

CHESTNUT BARK DISEASE.—The investigation of the destructive bark disease of the native chestnuts in the region about New York

City and in adjacent States has been conducted by Doctor Metcalf. The disease is more prevalent than was first reported, and has been found in many localities in a number of States extending from Connecticut to Virginia. Experiments are being made to find means to prevent the threatened extermination of the native chestnut trees. A report on the immunity of the Japanese chestnut to the bark disease has been published.

WHITE PINE BLIGHT.—The investigation of the white pine blight has been continued by Doctor Spaulding in the Northeastern States. Numerous diseases have been confused with the so-called white pine leaf-blight. The leaf-blight of 1907, which partially killed the needles during the summer months, is much less prevalent this year, being confined chiefly to the trees formerly attacked, some of which are apparently recovering. The cause of the leaf-blight is still uncertain.

Three different forms of white pine twig-blight, which have incidentally been confused with the leaf-blight, are now known—one caused by a species of fungus, Lophodermium, is of minor importance; another is caused wholly or in part by the action of insects; and a third is apparently a winter injury, being limited to the northern side of diseased trees. This investigation has been conducted in cooperation with the Bureau of Entomology.

DAMPING-OFF OF CONIFEROUS SEEDLINGS.—Experiments on the control of the damping-off of coniferous seedlings have been conducted in cooperation with the New York Forest, Fish, and Game Commission and the Vermont Forestry Commission, under the direction of Doctor Spaulding. The results show that dilute sulphuric acid is effective in controlling the disease, but further experiments will be conducted to determine the exact strength which is most efficient. A report of some of the earlier experiments has been published.

OTHER DISEASES OF CONIFEROUS TREES.—In the forests of the Western States Doctor Hedgcock has been investigating a number of wood-rotting diseases of pines, spruces, firs, and larches, and in the forests of the Eastern States Doctor Spaulding has been making a similar investigation. This work will be continued and reports will be submitted on at least two diseases the coming year. An accumulation of data is being secured relative to the diseases attacking the various species of conifers in western forests, to ascertain what kinds of trees are most resistant to attacks of fungi and most suitable for reforesting lumbered and burned areas.

A study is being made of the various rusts attacking forest trees, especially conifers, with the hope of finding methods of extermination. A number of wood-rotting fungi which are not parasites have been subjects of investigation, and the work will be continued. The cytology of wood rots will also receive attention.

A serious twig-blight disease of fir trees has prevailed in a number of sections in the Northern and Eastern States. A species of Nectria has been found attacking trees in some localities. A thorough investigation of the disease will be made the coming year.

MISTLETOE DISEASE OF TREES.—A preliminary survey has been made by Doctor Hedgcock of the extent and importance of the disease of a number of species of oak, elm, hackberry, cottonwood, and other deciduous trees caused by Phoradendron. The disease is increasing rapidly in many localities and is becoming a serious menace to shade and ornamental trees in Texas and other Southern States. This mistletoe occurs on a diversity of host trees over the southern portion of the United States from the Atlantic to the Pacific. A report on the subject is in preparation.

The diseases of coniferous trees caused by a number of species of mistletoe have been under observation and study for a number of years. Considerable data have been collected during the past year, and the work will be continued. Especial attention will be given to possible methods of extermination.

MISCELLANEOUS DISEASES OF TREES.—The study of ambrosia and wood-staining fungi has been continued. Entomogenous fungi attacking forest and ornamental trees will receive attention the coming year in cooperation with the Bureau of Entomology. A tree-disease survey is being conducted in cooperation with Mr. W. A. Orton, of this Bureau, and data have been collected on the occurrence and prevalence of tree diseases in the United States.

SOIL BACTERIOLOGY AND WATER PURIFICATION

The investigations in soil bacteriology and water purification have continued in charge of Mr. Karl F. Kellerman, Physiologist. A summary of the work of the past fiscal year and an outline of plans for the ensuing year follow.

SOIL BACTERIOLOGY.—The investigations in general soil bacteriology, especially in the Great Plains region, are yielding some interesting results. The nitrifying power of western soils seems considerably higher than that of eastern soils, and this seems to be due to two reasons—first, because the nitrifying bacteria themselves are more numerous and more active in western than in eastern soils; and, second, because denitrifying bacteria are very much fewer in western soils than in eastern soils. The importance of this in crop production is obvious, and as our research work develops further we hope to discover the conditions under which nitrification can be maintained at a maximum during the growing season of crops. In our laboratory experiments we have found that under control conditions denitrifying bacteria can be made injurious to seedling plants of several kinds. During the present year this investigation will be duplicated as nearly as possible under field conditions to determine how serious and how general an injury to crops may be due to this type of bacterial action.

LEGUME BACTERIA.—The distribution of pure cultures of the nodule-forming organism for legumes has been continued and with even slightly better success than in previous years. Experiments have been carried on with types of soil which because of peculiar conditions prevented the growth of the proper legume bacteria and consequently made it impossible to grow leguminous crops. By the preparation of extracts of the soil and gradually adapting the nodule-forming organisms to the peculiar conditions, we have been able in some cases to satisfactorily inoculate the legume in regions heretofore nimical to pure-culture inoculation.

In some regions we have evidence that certain other bacteria must be present before the nodule-forming organism can be of much benefit to legumes. Experiments upon this subject are under way, and during the coming year it is hoped that both the chemical and the bacteriological questions involved in this work may be solved. It is proposed also to undertake some investigations concerning the influence of climate and temperature upon the type of organism.

Investigations upon the value of inoculated legumes as green manures for tobacco are under way, and it is believed that by these methods a large saving will be effected by reducing the necessity for using commercial nitrogenous fertilizers.

WATER PURIFICATION.—The investigations in water purification are now confined entirely to farm water supplies. From the results secured in preliminary studies it is believed that important general recommendations can be made for the improvement of farm sanitation. We have found that there is unfortunately a need for improvement in the average farm condition, and it will be impossible to depend upon a chemical treatment for these bacterial pollutions. Although on farms the lakes containing odor-producing algæ are rare, we have had our usual success in eradicating these growths by the copper method. Our previous investigations upon the disinfection of sewage are now being put to practical use by the State Board of Health of Ohio.

PLANT LIFE HISTORY INVESTIGATIONS.

The plant life history investigations of the Bureau have continued under the immediate direction of Mr. Walter T. Swingle, Physiologist, with Mr. Charles J. Brand, Physiologist, in charge of clover and alfalfa investigations, and Prof. Silas C. Mason, Arboriculturist, in charge of dry-land arboriculture investigations. These investigations have for their object the working out of the requirements as to soil, climate, and culture of crop plants and the limiting factors controlling their commercial culture. The investigations are carried on in a practical way with some of the principal crop plants and consist primarily in the application of modern scientific methods to the study of crop plants whose culture furnishes employment for hundreds of thousands and whose products furnish the daily subsistence of tens of millions of people.

The progress made during the past fiscal year in these lines of work is briefly stated in the following.

COOPERATION WITH THE INDIAN SERVICE.

Cooperative work in agriculture has been inaugurated in connection with the Indian reservations of the Southwest. Active work has been started at Sacaton, Ariz., under the immediate supervision of Mr. E. W. Hudson for the Bureau of Plant Industry and Mr. M. French Gilman for the Office of Indian Affairs of the Department of the Interior.

The larger Indian reservations have an abundance of good Indian labor, as well as good equipment of horses, wagons, etc. Farms and gardens are maintained on a considerable scale. Under these conditions it is advantageous to engage in cooperative testing and demonstration work. New crops and new methods of culture can be introduced and the Indians educated not only to grow profitable crops for themselves but also to become skillful and trustworthy helpers for the white settlers residing near by.

Cooperative testing and demonstration garden at Sacaton, Ariz.—The cooperative testing and demonstration garden on the Pima Indian Reservation at Sacaton, Ariz., is one of the best experimental stations in the western United States. Here 55 acres of nearly level irrigated land of good quality have been set aside for ordinary experiments with irrigation, and an additional 10 acres have been fenced off for experiments with dry-land olives and other crops which may possibly succeed without irrigation in spite of the limited rainfall and intense heat of this part of the Southwest. These experiments have been undertaken primarily to provide new crops for culture by the Indians themselves and to instruct them by object lessons as to the best methods of caring for the crops suited to the climatic and soil conditions of the various reservations.

During the past year experiments have been inaugurated in onion culture and the testing of new and superior varieties of alfalfa. A very large planting has been made of acclimatized Egyptian cotton, improved by Messrs. T. H. Kearney and W. A. Peterson, of the Bureau of Plant Industry. Some 20 acres of Egyptian cotton, the largest single field in the New World, are now being grown on the grounds of the testing and demonstration garden at Sacaton. It is believed that this crop is well adapted to the climatic and soil conditions of central Arizona and it is, moreover, particularly valuable because of a market being already established for it, since it is not perishable and is worth enough to bear being shipped long distances to market.

It is proposed to cooperate with the Office of Indian Affairs in educating the Indians, not only in the culture and picking of cotton for themselves but to become skillful pickers for the white settlers. It is believed that ultimately the Indians will be able to grow small fields of cotton themselves, to be picked by the old men and the women, while the younger men pick the crops grown by the white settlers in adjoining regions. These experiments in Egyptian cotton culture are being undertaken in cooperation with Messrs. T. H. Kearney and C. S. Scofield, of this Bureau.

A considerable plantation of the best varieties of the pecan nut, as well as a number of grape varieties, has been made at Sacaton, this work being in cooperation with the pomologists of the Bureau. Extensive plantations have also been made of pistaches, dates, figs, and citranges.

Plans for the extension of the work.—It is hoped to extend this cooperative work with the Office of Indian Affairs to certain other reservations in the Southwest. In particular, it is believed that the Colorado River Indian Reservation, at Parker, Ariz., should have a testing and demonstration garden. This is a region until very recently almost inaccessible, but soon to be on the main line of the Santa Fe Railroad. Both the Indians and whites of this region are in urgent need of object lessons in improved methods of agriculture, especially in the growing of new and more profitable crops.

A preliminary reconnaissance will be made in the summer of 1908 to determine what cooperation can be undertaken on the Indian agency farm at Shiprock, N. Mex. This farm, which comprises 200 acres under irrigation, is situated in the valley of the San Juan River, in the center of a considerable region known as the San Juan country, lying in the corners of four adjacent States or Territories (New Mexico, Arizona, Colorado, and Utah).

Plans are being considered for the inauguration of cooperative testing and demonstration work on the reservations at Banning and Palm Springs, Cal. At Palm Springs the climatic conditions are unusually favorable for growing, testing, and propagating many kinds of fruit, nut, and other crop plants which could afterwards be sent to the other reservations in the Southwest for trial.

DATE CULTURE.

The possibility of growing first-class dates in the southwestern United States has been demonstrated, and commercial plantings are beginning to be made. The growers, however, need expert advice in the selection of varieties, since the date palm, unlike most other fruit trees, can not be grafted over if the variety happens to be unsuited to the locality where planted. The date grower must therefore know in advance just what varieties to plant.

Cooperative date gardens.—An importation of 149 date offshoots, comprising 17 fruiting varieties and 5 male trees, was received in May, 1908, through Hon. William C. Magelssen, American consul at Bagdad, acting for the Office of Foreign Seed and Plant Introduction of this Bureau. Of these, 32 were sent to the Cooperative Date Garden at Laredo, Tex., 34 to the Cooperative Date Garden at Tempe, Ariz., and 83 to the Coachella Valley in California, where the greater number were planted in the Government date garden at Indio. The vitality of all of these was high, and the promise of growth is excellent.

Some of the palms imported from five to eight years ago and planted in the Cooperative Date Garden at Tempe, Ariz., have begun to produce offshoots. The Department of Agriculture received this year 252 of these offshoots, of excellent size and quality. Of these, 153 were sent to the date gardens at Indio and Mecca, Cal., and 62 to the Cooperative Date Garden at Laredo, Tex., the remainder being distributed to private growers for planting on alkali lands in Arizona.

Date seed distribution.—On account of the great expense and trouble of importing offshoots from the remote oases of the Old World deserts and because of the need for experience in handling such offshoots, the plan was adopted of distributing seeds of the best varieties of dates, not only in the hope of originating valuable new sorts, but also, and primarily, to accustom the growers to the culture and handling of date palms. Offshoots of imported varieties are also distributed, as a bonus for their work, to those who plant date seeds. In this way planters get experience not only in growing date palms from seed but also in the rooting of offshoots in the field, a practice not followed in the case of any other commonly grown fruit tree.

The requests for date seeds and seedling trees have been increasingly numerous, all of the surplus seedlings at the Mecca garden—some 4,000 in number—not being sufficient to meet the demand. Over 100 lots of date seeds of choice varieties, approximating 200,000 seeds, have been distributed this year among responsible fruit growers, chiefly in southern California, but largely in Arizona.

BREEDING NEW TYPES OF CITRUS FRUITS.

The citrange, obtained by crossing the comparatively worthless Japanese hedge plant *Citrus trifoliata* with the common orange, is one of the most striking new fruits produced in America by the plant breeder's art. Over half of the hybrids secured have proved worthy of distribution, and six of them have been named and described by Herbert J. Webber and Walter T. Swingle in the Yearbooks of the Department of Agriculture for 1904, 1905, and 1906.

Citranges.—The work of breeding citrus fruits, conducted by Mr. E. M. Savage, has been rapidly pushed during the past year, especial attention being given to the securing of hardy types. The great variability of the few citranges already produced renders it probable that if a sufficiently large number of these hybrids can be made some of them will attain a high value. The citranges produced so far are substitutes for the lemon rather than for the orange. They are likely to prove useful for home consumption throughout the cotton belt in the Southern States and in the hot, dry valleys of Texas, New Mexico, Nevada, southern Utah, Oregon, and Washington, in regions too cold for the production of other citrus fruits.

It is believed that the Colman citrange may prove of commercial importance, as it is of large size, is excellent for making citrangeade (a refreshing drink similar to lemonade), and has a fairly thick skin, so that it could probably be shipped long distances and be kept a week or so without much loss from decay.

While the breeding of citranges has been carried on largely in Florida in the past, preliminary work has been done this year in Arizona and California, and it is hoped to extend the work largely in the future. In particular it is the intention to breed citranges in California for distribution within that State, so that there will be no possibility of the introduction of new insects or fungous pests. Precautions of this nature are imperative on account of the enormous capital invested in the citrus industry of that State.

Oranges.—Hardy types of oranges are being sought in all parts of the world and several promising sorts have been secured during the past year.

A new method of breeding navel oranges has been discovered by which it is hoped to secure variations of the parent type, and it is believed that some of these will be superior even to the Washington Navel or the Thompson's Improved. As a by-product of such breeding work a large number of new citranges will be obtained.

FIG CULTURE.

Smyrna figs.—During the past year investigations on the culture of figs of the Smyrna type have been continued, and it has been found that there is much need of advice and help in putting the numerous young fig orchards of the Southwestern States in a satisfactory condition. While some 24,000,000 pounds of figs were imported in 1907, we are now producing in this country only about 600,000 pounds of figs of the Smyrna type. A considerable number of orchards for growing figs of this type have been established in

California, however, and it is believed that a large number of these will prove financial successes.

Breeding new varieties of figs and caprifigs.—For the first time in the history of horticulture extensive experiments are being conducted in the breeding of new varieties of figs. Seedlings are being grown from many of the standard sorts—both of the Smyrna and other types. Such seedlings could not, of course, be obtained until the establishment of the fig insect rendered caprification possible.

It is proposed to encourage cooperative work in the breeding of new varieties of figs by asking all growers to plant a few seedling figs in their orchards in compensation for the valuable varieties of caprifigs that the Department is distributing. It has been found that a fair proportion of seedlings from the best Smyrna figs prove to be equal or even superior to the parent variety and, besides the new sorts of edible figs, new caprifigs are also produced.

COOPERATIVE WORK ON FRUITS

In view of the enthusiastic participation of the fruit growers of the United States in the experiments in cooperative plant breeding as applied to the date palm, citrus fruits, figs, etc., there is every reason to believe that a similar line of procedure can be applied to many other fruit and nut trees and eventually to practically all perennial crop plants.

Value of cooperative plant breeding to the farmer.—It has been found that a much greater degree of active personal interest is aroused by such cooperative work than is possible where the work of breeding and studying new varieties is carried on exclusively by the agents of the Department. Owing to their knowledge of local conditions cooperative growers are able to render valuable assistance in the cooperative work, and their observations often result in the discovery of new methods of great value.

This cooperative breeding work is likely to prove useful in at least three ways: First, crop plants bred in the localities where they are to be used are more likely to prove adapted to local conditions for that very reason; second, the breeding work is itself of great educational value, since it shows the farmer that it is within his power to bring about most radical improvement in the familiar crop plants; and, third, such work arouses an intellectual and scientific interest in farm life which will doubtless cause some of the brightest men to remain on the farm, where they can do the most efficient work for themselves and for the race.

Other lines of cooperative farm research.—Plant breeding is not the only kind of investigation which can be carried out successfully on the farm. The study of the best stocks upon which to graft the various fruit and nut trees is necessarily of a very local character and there is a chance for much valuable work on the part of the farmers themselves in settling such questions, preferably, of course, in cooperation with some office in touch with similar work throughout the country.

DRY-LAND ARBORICULTURE.

The investigations in dry-land arboriculture, which are conducted by Prof. Silas C. Mason, Arboriculturist, have for their object the discovery of deep-rooted and drought-resistant trees able to yield crops without irrigation and hence to supplement ordinary shallow-rooted crop plants in dry-land farming.

Dry-land olives.—Investigations have been continued upon the neglected olive orchards in the Southwest reported upon last year. It has been found that the trees growing at Casa Grande, Ariz., have developed a finely branched root system which completely occupies the surface layers of soil over a wide area, ready to appropriate moisture from even the lightest rainfall.

At Palm Springs, Cal., where the average annual rainfall is only 3½ inches, an olive plantation of 20 acres has been found which was planted in 1891 and in which the greater number of the original trees are now in vigorous condition six years after the failure of the irrigation supply. These trees have developed the same minutely divided type of roots noted at Casa Grande, Ariz., occupying the first foot of soil very completely for an area often eight or nine times that of the spread of the tops. With a stand of 75 and 114 trees to the acre, respectively, these deserted olive trees are undergoing a struggle for root space and moisture which shows that wide planting is essential to growth without irrigation under a rainfall of from 3½ to 9 inches annually.

Desert almonds and the Texas wild peach.—Work has been started on a group of wild species of Prunus variously known as "desert almonds," "wild apricots," and "wild peaches." This group comprises several species of hairy fruited shrubs or small trees more closely related to the apricots and almonds of the Old World than to our native wild species.

One species in Texas is already known for its delicious fruits, called "wild peaches," while another, in California, has shown excellent qualities as a stock for apricots and almonds in dry situations. The work of assembling these species in stations for propagation and study is being pushed as rapidly as the difficulties of the field work will permit. It is planned in connection with these promising American types to assemble a number of Old World forms of Prunus not yet known to American growers.

Ironwood—a valuable wood for knife and tool handles.—Along the washes in many sections of southern Arizona and California considerable areas of ironwood (*Olneya tesota*) may be found in scattering parklike growths. The wood is very heavy, hard, tough, and of a handsome yellow-brown color, taking a high polish. So far it has been used principally for fuel, as the trees do not attain sufficiently large dimensions for constructional purposes. For the purpose of making knife and small tool handles, brush backs, etc., ample material of very high quality can be found.

Samples submitted to a prominent cutlery company were worked into pocketknife handles and pronounced superior to the Cuban wood commonly imported for that purpose, and capable of replacing it in the cutlery industry. As the supply of woods for such uses is now wholly imported, it would be an item of some importance if choice woods from the arid and otherwise unproductive regions could be brought in to supply this demand. It seems probable that with cultural methods based on the natural modes of propagation of the species considerable areas of waste land might be utilized for the production of commercial supplies of this valuable wood.

SALABLE PRODUCTS FROM DESERT PLANTS.—A number of desert shrubs and plants are under observation and considerable progress has been made in extracting resinous and coloring materials from them.

The greasewood or creosote bush (*Covillea tridentata*) gives much promise in the production of varnish material, and a species of Dalea, a thorny desert shrub, yields a vivid yellow coloring matter. As both these shrubs occupy large areas of now wholly worthless land, the securing of a commercial product from either would be an important consideration. These investigations will be continued during the coming year.

THE PISTACHE NUT.—Thousands of pistache stocks upon which improved varieties can be grafted have been distributed throughout the Southwest. One of the most important of these is the Chinese pistache (*Pistacia chinensis*) introduced by the Office of Foreign Seed and Plant Introduction from the vicinity of Peking, China, where the winters are about as cold as at Washington, D. C. This species is of rapid growth, and it is hoped that it will prove to be a valuable stock upon which to graft the hardier varieties of the pistache. Every effort is being made to propagate budwood of improved varieties, so that the stocks now growing in various parts of the country can be grafted to the best commercial varieties of the pistache nut.

THE CHINESE DATE.—The Office of Foreign Seed and Plant Introduction has succeeded in securing from China scions of several valuable varieties of the Chinese date, or jujube, long cultivated in China for its delicious fruit, some forms of which are known to the markets of the Pacific coast. These are being tested in the drier parts of the country and stocks are being grown upon which to graft them. Several wild species of Zizyphus and the closely allied genus Condalia have been studied as probable stocks for the improved variteies. It is hoped that it will be possible to locate many of the large jujube trees which were introduced from Europe some twenty-five years ago by Mr. G. P. Rixford and distributed throughout California. These large trees could readily be top-grafted to the improved sorts.

ALFALFAS AND CLOVERS.

The life-history investigations of alfalfas and clovers have been conducted, as in the past, by Mr. Charles J. Brand, Physiologist.

CLOVERS.

During the year some emphasis in the clover work has been put on the study of the wild species of Trifolium of both Europe and America, with a view to determining which of them may be adaptable for cultivation. About 10 native and 50 foreign species and varieties have been grown side by side for purposes of study and propagation of seed.

A NEW CLOVER FOR THE PACIFIC COAST.—The most striking result of the year in this phase of the work has been the discovery that *Trifolium elegans*, a wild European relative of the well-known alsike clover, is a valuable plant for cultivation in northern California and Oregon. This species has been found to surpass in that section the famous Ladino variety of white clover, which it closely resembles in its methods of growth.

The experiments which have led to these conclusions were conducted at Etterburg, in Humboldt County, Cal. In common with the Willamette Valley country of Oregon, this section has a very low rainfall from May to October. A clover to be valuable here must be able to endure a long period of drought during the summer season. Mr. Albert F. Etter, a successful plant breeder and an authority on the forage plants of California, in cooperation with whom this work has been carried on, finds this species superior to alfalfa and all other clovers for this region.

A NEW CLOVER FROM THE HIMALAYA MOUNTAINS.—The experiments begun last year with shaftal (*Trifolium suaveolens* Willd.) have not progressed far enough to make possible a fairly accurate appraisal of the value of this promising annual clover. It has grown most successfully in our very hottest irrigated valleys, and in Yuma Valley, Ariz., produced three cuttings of hay and a moderate crop of seed in the same year. With the advent of Egyptian cotton culture this clover may find an important place in crop rotation in the Southwest.

ALFALFA.

Attention was called in Bulletin 118 of this Bureau (Peruvian Alfalfa: A New Long Season Variety for the Southwest) to the fact that alfalfa is not a homogeneous species, but is composed of numerous distinct races which are adapted to different conditions of soil and climate and which require different cultural treatment. It becomes of importance, therefore, to pick out the valuable races and discard the inferior ones. For this purpose nurseries for selection and breeding work and for the study of the life history of individual plants and their progeny have been established. These life history nurseries have been located largely with reference to securing as complete a representation as possible of the type conditions of soil and climate of the western United States. The principal stations are located as follows: Dickinson, N. Dak.; Stockton, Kans.; Nephi, Utah; Fallon, Nev.; Sacaton, Ariz.; and Yuma, Ariz., in the hottest part of the Colorado River Valley.

GRIMM ALFALFA.—On account of its great hardiness in the Northwest additional studies of the valuable Grimm strain of alfalfa from Minnesota have been made during the year.

PERUVIAN ALFALFA.—The life-history study of Peruvian alfalfa has been continued, special attention being given to the production of seed to make possible the widest utilization of this valuable variety in the area to which it is suited. Several lots of seed believed to be true to type have been secured during the present year from the Andean region and will be devoted exclusively to seed production. The observations of the present year add confirmation to the good reports previously published as to the high value of this variety.

INVESTIGATIONS OF DRUG AND OTHER SPECIAL CROPS AND OF POISONOUS PLANTS.

The work on drug plants, industrial alcohol, American tea, poisonous plants, and other special problems has continued under the immediate direction of Dr. Rodney H. True, Physiologist. The lines of investigation have taken the same general course as last year, except in such few instances as are hereafter mentioned.

DRUG-PLANT INVESTIGATIONS.

Up to the present time the work carried on at the drug-plant testing gardens has necessarily been of a somewhat preliminary nature. Drug plants furnishing products now in demand in the American drug market, but not hitherto grown under American agricultural conditions, have been planted in these gardens and their behavior observed. The proper methods of planting, cultivating, and propagating have been studied. As soon as this necessary fundamental information has been obtained, work on a larger scale fitted to test the practicability of growing drug plants in a commercial way has been undertaken. In some cases we have sought to improve the product in quantity or quality by means of the methods of the plant breeder. In other cases, different methods of handling, fertilizing, etc., are being experimentally investigated in their relation to the amount of active principle present in the plants.

Progress in testing plant drugs.—At the drug-plant testing garden at Arlington, Va., a great many foreign plants have been under observation. Tests to show whether the amount of active principle present can be increased by fertilizers have been begun with promising results. A small garden of American-grown varieties of hops has been planted, thus producing an interesting test on a small scale of a considerable number of sorts under like conditions. In order to permit the necessary extraction and distillation of the products grown experimentally, a small field laboratory has been equipped on the Arlington Experimental Farm.

In South Carolina the work at Ebenezer and Florence has consisted chiefly of experiments on a large scale with a few products chosen because of their promise in smaller preliminary experiments. Although unseasonable frosts in both the spring and fall did much injury, about 10,000 pounds of paprika peppers and American wormseed were grown, cured, and sold in the open market at profits comparing very favorably with those obtained under like conditions from the usual farm crops in the neighborhood. By means of cold frames sufficient in area to protect the seed beds, it is hoped to avoid danger from spring frosts.

At Pierce, Tex., small tests have shown some promising results, especially with red peppers and camphor, but the outlook at the present time is not hopeful on account of the prevailing labor conditions. The experimental work in Florida has been largely shaped by the camphor investigations conducted in that State.

Camphor investigations.—The camphor work of the past year has consisted largely in starting young stock from parent trees carefully selected for camphor content. To get this result samples of material were carefully distilled from well-shaped, healthy, seed-bearing trees having a good rate of growth. Where the gum content was found to be high, seeds of the trees were obtained for planting. The outlook for the future of camphor growing in Florida seems to make a practical appeal to investors, a second large camphor plantation having been established during the year.

Small trees planted at Pierce, Tex., as a windbreak about the fields have thus far made a very favorable growth. This seems to indicate that the camphor tree might do well in parts of that State, but the experimental trees are not yet large enough to permit a fair judgment of the camphor yield likely to result.

POPPY INVESTIGATIONS.—After a number of discouraging attempts to get sufficient material for a test of the practicability of obtaining poppy alkaloids directly from the plant capsules, success has resulted from a planting in eastern Washington. A yield of about 900 pounds per acre of very good seed and about 700 pounds of capsule walls was obtained. The seed was sold in open market at the top prices, showing a good net profit. The extraction and separation of the alkaloids from the capsule walls will be completed as soon as possible.

MISCELLANEOUS INVESTIGATIONS.—An investigation has been begun of the much-discussed anti-opium plant of the Malay Peninsula, *Combutum sundaiacum*, reported to possess valuable properties as an aid in overcoming the opium and morphine habits. The favorable reports received from the Orient have in a measure been supported by the results already observed here.

Several other miscellaneous subjects have had attention during the year. Indian hemp grown experimentally at the Arlington Farm from seed obtained from commercial sources has been put to physiological tests, which have shown that the American-grown drug in these cases was as active as the standard commercial article. Licorice culture has received some attention in a small experimental way; thus far, however, with but limited success.

On account of the large quantity of peach and apricot kernels produced annually in the fruit-growing sections, a study of their possible uses was made. It was found that valuable fatty and volatile oils could be readily produced, and a bulletin embodying these results was submitted for publication.

SPECIAL PROBLEMS.

Various problems of a special nature, closely connected with the drug-plant investigations but not strictly falling under that head, have received attention during the past year. These include the investigations of the handling of American hops and lemons, the production of industrial alcohol on the farm, and the growing and handling of American tea.

HOP INVESTIGATIONS.—A study of hop drying has been continued in California and the effect on the principal constituents resulting from the different methods employed has been under investigation. As a special problem, the source of small amounts of arsenic occasionally found in both foreign and domestic hops was sought. It was made clear that in the case of our domestic hops little arsenic is absorbed by the plant even though the soil is watered frequently with arsenic solutions of considerable concentration. The source was found in the impure sulphur used in sulphuring the hops. This conclusion is one of great importance to the hop industry and seems to make the cure of this long-standing trouble easily possible. It may also have a very important bearing on the sulphuring of fruits and other products used in foods or drinks. A study of the top mold still in progress has yielded some very interesting suggestions. A somewhat extensive planting of hop seeds of different origins has been made in the hope that improved sorts may be developed.

LEMON INVESTIGATIONS.—During the past winter the study of the conditions under which lemons are grown and prepared for market has been continued. Fruit handled in various ways has been shipped to Washington and held for keeping tests. Tree-ripened, tent-cured, and sweated fruit have had careful laboratory study and important indications have been obtained. It seems probable that the cause of the deficient keeping quality of the American fruit is due in part to poor methods of handling, but to a much greater degree to some fundamental weakness, the source of which is not yet revealed. Time, patience, and careful scientific work both in the lemon houses and in the field seem still to be required for the solution of this problem.

DENATURED ALCOHOL INVESTIGATIONS.—This new line of work has primarily to do with the utilization of cheap or waste fermentable products of the farm for the manufacture of denatured alcohol and deals with the situation from the standpoint of plant industry.

In order to get the benefit of European experience in this work, Dr. Edward Kremers, of the University of Wisconsin, as a special agent of this Department, visited England, France, and Germany and investigated the existing conditions. The situation in Germany was found to give most valuable suggestions, and several months were spent at the great center of interest in Berlin and in visiting agricultural distilleries of various types situated in different agricultural environments. These observations have furnished a basis for planning future work. One of the first tasks involved in a conservative investigation of this subject seems to be found in careful determinations of the alcohol value of such waste and cheap farm products as seem to promise favorable raw materials for the manufacture of alcohol. Since these are in considerable part perishable, these tests must necessarily be carried out at the places of production. Laboratory studies will be necessary to the development of certain technical phases of the work.

TEA-CULTURE INVESTIGATIONS.—The tea work up to date has demonstrated the following important facts: That tea will grow well in the right places in this country and produce an abundant yield, and that this yield of leaves can be made into excellent tea. The agricultural and manufacturing aspects of the tea situation have been in a very great measure worked out. The problem of marketing is at present the chief unsettled point. Tea dealers are conservative and do not seem desirous to alter existing commercial relations except under prospects of increased profits. The American article seems, therefore, to be at a disadvantage in the competition, having to meet more rigorous conditions than the imported teas. This phase of the situation can be affected by the Department chiefly through continued efforts to reduce the cost of production. This is being done mainly through an attempt to develop labor-saving machinery.

The situation at the Summerville (S. C.) tea garden, under the management of Dr. C. U. Shepard, is very promising. The production of tea is satisfactory, and an increased demand for American tea absorbs the product. The cost of production is being reduced and the quality of the product is steadily improving, while the yield does not diminish in quantity. The outlook for the experiment at Pierce, Tex., is less encouraging. Occasional floods inundate the country and the tea fields have suffered so severely and so often that it seems increasingly evident that the situation is not favorable for this work. The great difficulty in getting labor, a trouble which has become increasingly acute during the last few years, seems to add a final obstacle. It seems, indeed, advisable to abandon tea work here, and this will probably be done the coming season.

POISONOUS-PLANT INVESTIGATIONS.

The work of the past year on poisonous plants has consisted of field investigations, largely carried on in the grazing regions of the West, and laboratory investigations at Washington. The field work was further broadened during the year by the effecting of cooperative relations with the Forest Service to investigate stock-poisoning problems in the national forests.

Loco weeds.—The loco-weed investigations have received especial emphasis. The field work was continued at Hugo, Colo., in cooperation with the Colorado Agricultural Experiment Station. A preliminary survey of the loco situation in Arizona and New Mexico was made. The field work has developed clearly the cause and symptoms of the loco-weed disease, and methods of treating horses and cattle, when conditions permit individual handling, were worked out. Nearly all locoed animals, when taken up before the final stages of the disease, can be cured. These investigations showed that the most dangerous of the so-called loco weeds of eastern Colorado is the "rattleweed," *Aragallus lamberti*. Less destructive but more poisonous is the "woolly loco weed," *Astragalus mollissimus*. These plants, upon investigation in the laboratory, were found to contain the poisonous element barium, which the plants take up from the soil. Reports presenting these results in detail were prepared and submitted for publication.

Larkspurs.—Next to the various loco weeds, the larkspurs are probably the plants most injurious to the grazing interests of the West. In the mountains the damage wrought is very great. Preliminary field surveys during the year make it apparent that the situation is so bad as to demand a more serious consideration than it has yet received.

Plants causing disease.—An investigation of the cause of milksickness has been made. This once serious disease of domestic animals and man has been widely attributed to the eating by animals of the white snakeroot, *Eupatorium ageratoides*. A favorable opportunity to test this hypothesis was accepted, with the result that no evidence could be found tending to connect this plant with the disease. A bulletin embodying these results was published.

Attention has also been given to the serious disease of sheep known as "bighead," which occurs especially in Idaho, Wyoming, and Nevada, and has been very generally charged to unknown poisonous plants growing in the regions concerned. A serious attack of the disease was observed at Soda Springs, Idaho, but such work as could be done during the short period covered failed to establish any relation between the disease and plants. The cause of this trouble remains still to be established.

COOPERATIVE WORK WITH THE FOREST SERVICE.—Much loss is sustained by stockmen using the National Forests on account of the poisonous plants found therein. During the year a cooperative study of this situation has been arranged with the grazing branch of the Forest Service. This work consists of an investigation of the conditions of such of the forests as have been the subject of complaint, the identification and location of the poisonous plants being followed by the fencing in of dangerous areas, eradicating the weeds or otherwise protecting the stock, and such other measures as tend to reduce losses.

PLANS FOR FUTURE WORK.

The work of the coming year should continue along the general lines already laid down, with such modifications as new conditions or exigencies may require.

DRUG PLANTS.—In the drug-plant investigations, it is hoped that it may be practicable to establish a testing garden in southern California for the trial of such crops as seem to demand the conditions found there. The drug work in South Carolina should be increased both in variety and in extent. The indications for building up a drug-growing industry in that State seem to be good. The poppy work, it is hoped, may be so far advanced during the coming year as to permit us to practically close up the project. The camphor and other drug-plant work will be prosecuted as heretofore.

HOPS AND LEMONS.—The hop work should be continued along the present lines, but the field investigations should reach important hop sections that have not as yet been carefully studied. The selection and breeding work should receive additional attention. The lemon work, in order to become properly effective, should be carried out on a larger scale and on a broader basis than heretofore. For this purpose more assistance and increased facilities are required.

DENATURED ALCOHOL.—As it appears clear from German experience that alcohol manufacture flourishes best when combined with dairy farming or with some other plan of operation in which farm animals play an important rôle, it seems probable that cooperative experiments undertaken in parts of the country producing regularly large amounts of cheap fermentable material and a reasonable quota of live stock, especially cattle, would have the best chances of success. As fast as circumstances permit, cooperative experiments should be undertaken in such regions as shall seem to best represent the promising types of conditions now existing in American agriculture. One such experiment should be put into operation during the coming year.

AMERICAN TEA.—In view of the considerations previously referred to, it seems probable that, having aided in working out the problems of growing and manufacturing tea, the Department of Agriculture has accomplished the greater part of its work for the establishment of an American tea industry. The affairs of the trade now constitute the crux of the situation and lie largely outside the sphere of influence of the Department. Accordingly, the work of the coming year might wisely be so directed as to bear chiefly on the perfecting of labor-saving machinery in order to further reduce the cost of production. At present practically all work is on a machinery basis except the pruning of the bushes and the plucking of the leaves. It seems very desirable to bring these processes also to such a basis. In view of the unfavorable conditions developed in the Texas experiment, it would be advisable to discontinue it. Unfinished important laboratory studies on technical aspects of the tea situation should be continued. These changes will reduce the requirements of the tea work to a very moderate basis.

Poisonous plants.—The work of the ensuing year will largely be determined by the condition of the unfinished work now in progress. The loco-weed situation should receive first consideration. The location and areas of the barium-bearing soils should be worked out. The plant physiological problems involved in the relation of the barium to the weeds absorbing it and the possible relation of barium to the crops and wild flora should be made subjects of careful study in order that the bearing of the barium situation on such plants as occur abundantly in grazing areas and in the agricultural crops of the region concerned may be finally ascertained. The loco situation in New Mexico and Arizona is so serious as to demand thorough investigation.

The possible relation of plants to the bighead disease should continue to receive such attention as may be possible. Larkspur poisoning should be most thoroughly studied in the field and laboratory, since the loss due to this group of plants is great. Among the important stock-poisoning plants demanding further study are the lupines, death camas, and various species of cicuta and related members of the parsnip family. The miscellaneous laboratory tests of suspicious plants should continue to give important information concerning plants whose properties have as yet remained uninvestigated.

Some effective means of eradicating poison ivy is very greatly to be desired. The dread inspired by the plant seems thus far to have protected it from effective attack, with the result that it is invading increasing areas of the East. The widespread inconvenience and even suffering caused by this group of species would amply justify very considerable effort in the direction indicated.

CROP TECHNOLOGY, COTTON STANDARDIZATION, AND FIBER INVESTIGATIONS.

The group of projects having to do with technological problems in connection with cotton, fiber, and other crops has been placed under the immediate direction of Dr. N. A. Cobb, Crop Technologist, with Mr. Lyster H. Dewey, Botanist, in charge of fiber investigations and Dr. R. L. Bennett, Special Agent, in charge of cotton standardization.

CROP TECHNOLOGY.

The work in crop technology is being rapidly developed along a number of lines. Following is a brief summary of the work of the year:

Laboratory investigations.—A working laboratory is being equipped as a basis for the study of problems connected with the preparation, marketing, and handling of raw agricultural products. A number of pieces of agricultural apparatus have been improved in connection with this work. Standard grain sieves, machines for splitting rushes, and other problems are under investigation. Information has been furnished on a number of occasions with reference to the best machines for specific purposes. Apparatus for producing improved illustrations with the camera lucida and solar camera has been developed and installed in the laboratory. This apparatus has received high approval from numerous investigators, both inside and outside the Department.

BIOLOGICAL STUDIES OF GRAINS.—A study of the biology of grain milling and breeding is being continued. Progress has been made in interpreting the terms of the original chemical analysis into biological equivalents. The prospect of getting good results from the biological study of the flour cell continues to be good. An increased number of investigators are turning their attention to the problems opened up in this direction. It is the aim to encourage investigation of this sort through cooperation with outside agencies.

In all the biological studies of the wheat grain the utility of the facts discovered is considered in connection with the subject of grain grading, as well as with that of milling and breeding. Studies have been made of the effect of various sieves on separating grains accurately, and a suggestion for a standard sieve, as previously referred to, has been formulated. Through the press and through correspondence an effort has been made to influence the nomenclature of wheat in the direction of an enumeration of qualities that may be at the same time variety characteristics.

COTTON STANDARDIZATION.

Since the agricultural committees of Congress first began to give the subject of cotton standardization serious consideration studies have been going on, and much preliminary ground has been covered. Standards have been secured from the most important cotton exchanges, and several conferences have been held with the object of discussing all phases of the question. At these conferences the importance of the subject and the difficulties involved have been fully developed.

PLAN OF THE WORK.—A plan of work has been evolved including a full consideration of all the problems involved in the raising, marketing, and spinning of cotton. It is proposed to base the new official standards on the old, more or less heterogeneous standards of the cotton exchanges, departing from any one of these standards only in so far as will be necessary to secure uniformity. At a later date it is hoped that the official standards will be elaborated, without alteration of their fundamental character, so as to be much more useful than any such standards have been in the past. It is not too much to say that we can now see clearly the possibility, by technical examination of the cotton fiber of this country, of so improving the classification that all interested in the cotton industry will be materially benefited. The more accurate measurement of staple has already begun, with results that point to a successful issue. A plan is being evolved that will probably result in a fairly accurate test of strength on hand samples of raw cotton. This is a much more difficult matter, but the prospect of good results is encouraging.

COTTON BALING AND HANDLING.—Studies have been made in the baling of American cotton, and a bulletin on the subject is being prepared. There is good reason to hope that studies of this nature are leading toward the much-needed improvement in the baling and handling of cotton. The annual losses to the American cotton industry in this connection represent millions of dollars, and it is believed that the adoption of official grades, uniform throughout the country, and the dissemination of a more accurate knowledge of grading will result in great improvements in the trade and will encourage a far better class of baling, warehousing, and handling.

TESTING AND MEASURING LINT.—The work of measuring the length of lint on seed cotton and testing accurately the breaking strain of the fibers is being carried on with a large series of cottons to furnish other offices of the Bureau with information as to these important characters in the varieties or strains with which they are working. Facilities are being secured for measuring the diameter as well as the length of fiber, and during the coming year these added tests and measurements will be made, to furnish more complete information regarding the physical characteristics of these fibers. This work is being carried on by Mr. L. H. Dewey.

CLASSIFICATION OF COTTON VARIETIES.—The field work of collecting information as to the characteristics, origin, and history of all the recognized varieties of American Upland cotton has been completed, as has the laboratory work of determining the weight of seeds, number of bolls required to produce a pound of lint, percentage of lint, and strength of lint. This information is being compiled for publication in a bulletin of the Bureau.

Mr. Frederick J. Tyler, who has had this work in hand and who has done excellent service in collecting a large amount of most valuable information, has resigned his position in the Department to return to his farm. Before leaving he prepared for publication a paper on "The Nectaries of Cotton," the result of careful research for characters available for the identification of species of Gossypium.

FIBER INVESTIGATIONS.

The work on plant fibers has been continued chiefly along lines previously begun. Particular attention has been given to the encouragement of the hemp, ramie, sisal, and henequen fiber industries. Some attention has also been devoted to the flax industry, the most encouraging feature of which is the fact that through the use of flax straw for binder twine the growers of flax for seed in Minnesota, the Dakotas, and Wisconsin are beginning to sow the seed and handle the crop so as to produce a better grade of straw.

HEMP.

EXPERIMENTS IN PENNSYLVANIA.—The hemp sown in the spring of 1907 at Hanover, Pa., was harvested, retted, and broken under the direction of this office. It was cut with a mowing machine and put in shock at a cost of less than $3 per acre, as compared with cutting by hand and laying in swath at $3 to $4 per acre in Kentucky, but required a little more labor than cutting with self-rake reapers, which are being used in increasing numbers for cutting hemp. It was broken on a portable power brake at the rate of about 800 pounds a day, comparing very favorably with the average output of a hand brake in Kentucky, 75 to 100 pounds a day. The fiber was of excellent quality, fully equal in all respects to "Kentucky rough prime."

This was the first hemp grown in that region within the memory of the present generation. The results were so encouraging that the farmers have taken up the work and sown 40 acres in the spring of 1908. The present outlook for this crop is good, and it seems likely that the cultivation of hemp will become established there, where a ready market for the fiber is found close at hand in the cordage mill.

EXPERIMENTS IN WISCONSIN.—In the spring of 1908 experiments in the cultivation of hemp were begun in cooperation with the Wisconsin Agricultural Experiment Station. About 15 acres were sown on the State farms in three different locations. Most of it is now making a promising growth. This office furnished the seed and gave directions for preparing the land and sowing. Plans are also being made to give personal supervision to the work of harvesting, retting, and breaking.

INTRODUCTION OF HEMP SEED FROM MANCHURIA.—Hemp seed from Manchuria, imported by the Office of Foreign Seed and Plant Introduction (Nos. 19486, 20056, 20057, 20058, and 20855), was planted for seed production or sown in small plats for fiber under the direction of this office at the State agricultural experiment stations at Lexington, Ky., St. Paul, Minn., Lincoln, Nebr., Fort Collins, Colo., Fargo, N. Dak., Berkeley, Cal., and Clemson College, S. C.; also by hemp growers at Havelock, Nebr., Courtland, Cal., and Northfield, Minn. In all instances the hemp was shorter and went to seed earlier than that from Kentucky seed. Seed was saved from No. 19486 at Havelock, Nebr., and sown there for fiber this season, but aside from this none of these trials gave promise of success.

A further introduction of seed from China (S. P. I. No. 22690) has been planted this spring in small plats for seed production in several different localities. The reports received thus far indicate that this hemp is much more promising than the other introductions.

IMPROVED RETTING PROCESS.—A quick-retting process, employed on a rather large experimental scale, in which several tons of stalks were treated, gives promise of important results. The stalks are immersed twenty to forty minutes in an inexpensive liquid at a boiling temperature. They are then taken out and as soon as dry are ready for breaking. This process gives a stronger, more uniform, and lighter colored fiber than can be obtained by dew-retting. By a variation of the treatment a fiber nearly as soft as water-retted flax is obtained.

MACHINE HEMP BRAKES.—Four different kinds of machine hemp brakes were in use in Kentucky in breaking the crop of 1907. Some of these produced fiber very similar in quality to that from hand brakes. All work much more rapidly and they handle successfully stalks retted too little to be broken on hand brakes, thus producing a stronger fiber and avoiding the risk of overretting.

RAMIE.

Possibilities of ramie culture.—Experiments in the cultivation of ramie in this country during the past fifty years have shown that the plant will grow well in rich moist soils in the Southern States, and also in the central valleys of California. Its cultivation has not been taken up on a commercial scale chiefly for lack of suitable decorticating machinery or processes for separating the fiber from the stalks.

Trial of ramie decorticator.—A machine for decorticating ramie was tried at Los Angeles, Cal., in April, 1908, and, although the conditions were very unfavorable in many respects, the results were encouraging. Several acres of ramie have been planted, and it is expected that during the coming year the machine will be thoroughly tested. This machine also works successfully in separating hemp fiber from the stalks.

SISAL AND HENEQUEN.

Identity of the plants.—There has been much confusion regarding the botanical identity and relationship of the plants from which the fiber known as sisal is obtained, and it has been supposed that the two most important ones were simply varieties of one species. It has now been determined beyond question that they are two distinct species. These are henequen (*Agave elongata* Jacobi), cultivated in Yucatan and Cuba, and sisal (*Agave sisalana* Perrine), cultivated in the Bahamas, Hawaii, German East Africa, and India. Both plants are native in Yucatan, but only the henequen is cultivated there for the production of fiber for export. Sisal, the more widely distributed of the two, produces a fiber of better quality but in less quantity, and the plant is shorter lived.

Introduction into Porto Rico.—Several thousand plants of both henequen and sisal, introduced into Porto Rico within the past two years by the insular government with the cooperation of the Porto Rico Agricultural Experiment Station and this Bureau, are growing well in nursery rows at the agricultural experiment station at Mayaguez, whence they are being distributed at a nominal price to planters. The larger plants will yield a crop of leaves within the next year or two. The soil and climatic conditions in limited areas of southwestern and northwestern Porto Rico are well suited to the growth of these fiber plants.

Experiments in Texas, California, and Florida.—With few and unimportant exceptions all of the sisal and henequen cultivated for fiber production has been grown in regions entirely free from frost. There are one or two very flourishing plantations of henequen near Victoria, Tamaulipas, Mexico, where the temperature falls to about freezing every winter. Sisal has been growing without cultivation and spreading along the coast of southern Florida since it was first introduced there by Doctor Perrine in 1834. More than three-fourths of the sisal plantations throughout the world have been propagated from stock originally from the plants of southern Florida, yet sisal has never been cultivated there commercially for fiber production. A few plants of sisal and henequen have been sent to the South Texas

Garden of this Bureau, near Brownsville, and also a few to Los Angeles, Cal., where they are set out in the open fields as a preliminary experiment to determine whether they will withstand the winter climate of those places.

GRAIN STANDARDIZATION.

The work of the Bureau embodying the investigations being carried on through the Office of Grain Standardization is under the immediate supervision of Mr. John D. Shanahan, Crop Technologist, assisted by Dr. J. W. T. Duvel, in charge of laboratory methods. The general object of these investigations is to study the present methods of handling and grading grain commercially and to show wherein such methods can be improved; to study the various kinds of damage taken into consideration in fixing the value of commercial grain and to determine their relative weights; to study the cause or causes of the deterioration of grain in storage or transit and to show how such deterioration may be avoided; and to study the milling and baking value of different classes, varieties, and grades of wheat in so far as such factors are of value in commercial grading.

FIELD LABORATORIES IN THE UNITED STATES.—In addition to the two laboratories first established in 1906 at Baltimore, Md., and New Orleans, La., four new laboratories were put into operation during the past year, one each at St. Louis, Mo., Minneapolis, Minn., Duluth, Minn., and New York, N. Y. In accordance with the authority granted by Congress in making the appropriation for these investigations, the new laboratories were opened at such places as would embody the widest range of conditions and where the investigations as carried on would furnish data covering the greatest number of classes and varieties of grain. Numerous requests were received for opening laboratories in other cities, but the limited funds available rendered the establishment of more than four new laboratories impossible. With the exception of a few changes made early in the year the following men were in charge of the various laboratories: Baltimore, Mr. C. A. Neal; New Orleans, Mr. E. C. Richey; St. Louis, Mr. W. P. Carroll; Minneapolis, Mr. L. A. Fitz; Duluth, Mr. Frank J. Ryder; New York, Mr. Clyde E. Leighty. The work in these laboratories consisted principally in making definite determinations of the moisture content, the different kinds and degrees of damage, the factors of color, the kinds and amount of impurities, the weight per bushel, the weight of 1,000 kernels, etc., of samples of grain either taken personally by officers of this Bureau or submitted by chief inspectors or grain merchants.

In all places where laboratories have been established we have had the cordial cooperation of the local exchanges, and it is believed that much good has been accomplished in bringing about the more general feeling that work of this character is practical and much to be desired by inspectors, shippers, receivers, and consumers of grain. Numerous cases have been brought to our attention in which the reports of the laboratories have determined the action taken in appeals and otherwise served in the satisfactory adjustment of disputes and claims.

LABORATORY AT LONDON, ENGLAND.—The laboratory at London, with Mr. E. G. Boerner in charge, was opened again this year during the late autumn in order to be in full operation by the time the early shipments of American corn were received by European buyers. Mr. Boerner has visited nearly all of the more important European grain markets and secured samples of grain from incoming cargoes for the purpose of determining the quality of grain exported from the United States and other grain-exporting countries, together with its condition at the time of discharge at European ports. These investigations have shown that much of the corn from the United States arrived in Europe in a badly damaged condition, especially that contained in the bunker hold and in the holds over the shaft tunnel. The extremely high price of corn in the United States during the spring of 1908 also afforded an excellent opportunity for the study of corn received from South American shippers, European dealers being able to secure it at much less cost.

WASHINGTON RESEARCH LABORATORY.—Aside from the seven field laboratories, including the one at London, England, a laboratory has been maintained at Washington, D. C., for the necessary investigational purposes, in charge of Dr. J. W. T. Duvel. This laboratory was inaugurated primarily for the purpose of developing methods and apparatus for quickly determining such factors as are essential in fixing the grade on any given lot of grain and to determine with some degree of accuracy the ratings which should be given the different factors now taken into consideration in the commercial grading of grain. During the year the method for determining the moisture in grain by means of the Brown and Duvel apparatus, which is now widely used for determining the moisture content of corn, has been further developed so that it is applicable to all grains. A new semiautomatic balance has been devised for use in the various laboratories, making it possible to weigh the separations quickly and accurately to twenty-five one-thousandths of 1 gram without the handling of individual weights. Considerable time has also been given to other apparatus, such as grain mixers, samplers, separators, etc. In cooperation with the Bureau of Chemistry, analyses have been made of various grades of damaged grain in order to determine its milling and feeding value.

GRAIN TRANSPORTATION INVESTIGATIONS.—In April and May, 1908, some preliminary investigations were carried on to show the changes which take place in grain during transit in railroad cars and lake steamers. In these investigations the factors of condition and quality, including the moisture and temperature of the grain, together with the relative humidity and temperature of the air, were carefully determined at the time of loading and again at the time of discharge at destination. While most of the grain was in good condition for shipment at this season, one car of corn examined at destination contained 22.9 per cent of moisture and showed a temperature of 125° F.

PLANS FOR FUTURE WORK.—During the coming year the work of grain standardization will be carried on along much the same lines as during the year just closed. However, the routine work in the field laboratories will be somewhat reduced and more time given to the investigation of special problems peculiar to the individual markets. A new laboratory will be opened in Chicago about September 1.

The investigations in the transportation and storage of grain will be pushed more vigorously during the coming year, giving special attention to the shipments of corn from Illinois, Iowa, and Nebraska to the Gulf ports, and thence to Europe. It was not possible to take up the question of artificially dried corn during the past year as originally planned, but this work will be given special attention during the coming year, and it is hoped carried to completion.

Since the inauguration of the work in grain standardization it has been desirable, as set forth in former reports, to have facilities for making milling and baking tests of various classes and grades of wheat. For the coming year arrangements have been completed for cooperative experiments with the North Dakota Agricultural Experiment Station whereby the Bureau can make use of the fully equipped experimental flour mill and baking laboratories of that station. Mr. L. A. Fitz will have charge of these investigations during the coming year.

SEED LABORATORY.

During the past year the Seed Laboratory has been conducted along lines similar to those of previous years under the direction of Mr. Edgar Brown, Botanist in Charge. Over 4,000 more samples of seed were received than in the preceding fiscal year, the total number being 24,715. The practical interest in seed-testing and pure-seed work is shown by the attention given this subject at the agricultural experiment stations and by seedsmen, as well as by farmers.

Seed testing.—The Seed Laboratory has continued to make tests for both mechanical purity and germination of samples of seed submitted for this purpose by farmers, seedsmen, and others. In connection with the seeds distributed by this Bureau, 2,717 samples have been tested for either mechanical purity or germination, or both. A portion of these were samples offered the Department and were tested previous to purchasing; the remainder were samples from seed actually purchased for distribution. Exclusive of packets of vegetable and flower seed, a memorandum of the analysis is sent with each lot of seed distributed, showing the kinds and number of any weed seeds present and the percentage of germination.

Adulterated seed.—The collection and examination of samples of clover, alfalfa, and grass seeds have been continued, with the result that the adulteration of most of our common farm seeds has practically ceased. There is still offered in the market, however, a considerable amount of both Kentucky bluegrass seed and orchard grass seed which is badly adulterated. The suggestion has been frequently made by seedsmen that Canada bluegrass seed is harvested with that of Kentucky bluegrass, and in order to determine this point definitely a careful examination of the Kentucky bluegrass seed-producing area in the States of Kentucky, Illinois, Missouri, and Iowa was made just previous to harvesting time. In no case was there evidence that mature seeds of the two kinds would be harvested together, showing that the presence of Canada bluegrass seed in that of Kentucky bluegrass is the result of deliberate adulteration. This condition as regards the natural occurrence of Canada bluegrass seed in that of Kentucky bluegrass seed is practically the same as was found last year in the examination of the orchard grass seed producing section, there being practically no evidence of natural mixture.

IMPORTED SEED.—The importation of yellow trefoil has practically ceased, but there are still large quantities of Canada bluegrass seed imported for use in adulteration of Kentucky bluegrass seed. During the past year 1,159 samples have been received from customhouses, each representing an importation of forage-plant seeds. Among them are found many lots of both red clover and alfalfa, as well as some lots of the less common grass seeds, which are practically worthless for seeding purposes. Dodder is always found in low-grade samples of red clover and alfalfa imported from Europe, and often in large quantities. As has been previously pointed out, it is important that some steps should be taken to prevent the importation into the United States of European screenings and seeds which are used only for purposes of adulteration.

VITALITY OF COMMERCIAL SEED.—The investigation of the average quality of various kinds of commercial seeds has been continued. About 5,000 packets of vegetable seeds, as sold by grocers, have been collected and are now being tested for germination. Germination tests have also been made of about 2,500 samples each of cowpeas and corn. The germination of the samples of corn which were submitted by farmers was found to be of a high average quality, and the germination of cowpea seed was very much better than that reported on last year.

NEBRASKA COOPERATIVE LABORATORY.—In January, 1908, there was started in cooperation with the Nebraska Agricultural Experiment Station, at Lincoln, Nebr., a cooperative seed-testing laboratory. The object of this laboratory was to test samples of seed for farmers and seedsmen in the State of Nebraska and adjacent territory, making it possible to save the delay required in sending samples to Washington. This laboratory has been appreciated by both seedsmen and farmers, as is shown by the fact that 463 samples were submitted for test, over one-half of them coming from Nebraska.

INSTRUCTION IN TECHNICAL SEED TESTING.—An opportunity has been offered seedsmen, as well as experiment station workers, to spend some time in the Seed Laboratory, in order to become acquainted with the technical methods of seed testing, as well as to learn to recognize the commoner seeds of cultivated plants and weeds. Several students have availed themselves of this opportunity, and their work here will undoubtedly result in better facilities at the experiment stations and seed houses with which they are connected.

PLANS FOR FUTURE WORK.—The operation of the cooperative laboratory at Lincoln, Nebr., has been so successful that it has been determined to locate a similar laboratory in cooperation with the Missouri Agricultural Experiment Station, at Columbia, Mo. This will be started in the fall of 1908.

Considerable time during the coming year will be devoted to farmers' institute work in the States of Missouri and Nebraska, in order to impress upon the farmers in these States the practical importance of seed testing.

Particular attention will be paid to investigational work on the germination of seeds, as it is desired to perfect accurate methods for testing many seeds under laboratory conditions, to which it has not been possible previously to give sufficient attention.

During the coming year a thorough study of the germination of forest-tree seeds will be undertaken in cooperation with the Forest Service. This is a subject which has received practically no attention in the United States and one that is of great importance on account of the growing interest in forestry.

This laboratory is now in receipt of frequent requests for instruction in the technical methods of seed testing. These inquiries, coming both from the seed trade and experiment stations, show the general interest in better seeds. Although our laboratory facilities are limited, an endeavor will be made to accommodate all those wishing assistance along this line.

PHYSICAL LABORATORY.

The work of the Physical Laboratory has continued under the direction of Dr. L. J. Briggs. The investigations during the past year have been mainly along the lines indicated in the preceding report, viz: (1) The investigation and quantitative measurement of the environmental factors controlling the growth of dry-land crops; (2) the determination of the soil conditions which make tobacco most resistant to the root-rot; and (3) investigations on the influence of electricity on the growth of crops. The progress made in these lines during the past fiscal year is summarized in the following:

Physical investigations in dry-land agriculture.—This work is being carried on in close cooperation with the Office of Dry-Land Agriculture. Systematic measurements are being made throughout the growing season by the field representatives of the Office of Dry-Land Agriculture at each of the dry-land stations in the Great Plains. These measurements embrace as comprehensive a study of the conditions at the stations as the available time will permit, and include records of the temperature of the soil and air, the humidity of the air, the precipitation, and the evaporation from a water surface. Weekly determinations of the moisture content of the soil to a depth of 3 feet or more on the plats representing the cultural experiments with corn and wheat have also been made during the growing season. Measurements of this kind have for their ultimate object the determination of the relation of environmental factors to the growth and yield of the principal crop plants. Such determinations are of fundamental importance in the proper interpretation of cultivation and rotation experiments. The observations serve to establish the normal conditions which prevail at each station and furnish the basis for determining (1) the behavior of each crop or variety under normal conditions and (2) its behavior under conditions of measured abnormality. The results obtained under abnormal conditions are of value in two ways: (1) In showing the adaptation of the crop to the range of environmental conditions experienced at the station and (2) as a basis for its introduction into other regions. In connection with the rotation and cultivation plats, such observations show the actual merits of the different methods employed in conserving the moisture and maintaining the fertility of the soil. Observations are being conducted at present at Amarillo and Dalhart, Tex.; Akron, Colo.; Bellefourche, S. Dak.; Havs and Garden City, Kans.; North Platte, Nebr.; Edgeley and Dickinson, N. Dak.; Moore, Mont.; and Nephi, Utah. The work at the latter station is in cooperation with the Office of Grain Investigations.

These measurements have excited the interest and approval of workers generally in the field of dry-farming investigations, and it is believed that the work is of sufficient importance to justify the entire time of a man at each station where dry-farming investigations are being carried on. A feature of special interest is the determination at each station of the evaporation from a tank of water 8 feet in diameter, buried so that the surface of the water is level with the ground. Measurements during the past two years have shown that the evaporation in the southern part of the Great Plains area is almost twice that which occurs in the northern part during the six summer months. That is a factor which must be given serious consideration in the selection of dry farms. In two regions having the same rainfall, dry farming may be a success in one case and a failure in the other owing to the difference in the amount of evaporation. Heretofore, precipitation has been practically the only factor considered in this connection. It is evident that evaporation is of equal importance.

Another feature of the work this year has been the determination at a number of the stations of the growth and composition of wheat and oat plants from week to week until harvested. Such measurements show effectually the influence of environmental conditions upon the development of the crop, and furnish a basis for determining the controlling factors far more accurately than can be done from an analysis of the total yields at the end of the season.

INFLUENCE OF SOIL CONDITIONS ON THE DEVELOPMENT OF TOBACCO ROOT-ROT.—For a number of years the tobacco growers of Connecticut, Iowa, Wisconsin, and Kentucky have been troubled by the occurrence of a root-rot in their tobacco fields due to a soil fungus, *Thielavia basicola*. At the request of the Office of Tobacco Investigations, field and greenhouse experiments were undertaken to determine the influence of soil conditions upon the development of the fungus. The results of the experiments show that the fungus attacked the tobacco most severely when the soil was alkaline. This condition has been produced in a number of fields in Connecticut by the use of very large amounts of lime and carbonate of potash as fertilizers. Circular No. 7 of this Bureau, describing the experiments, was distributed among the tobacco growers of the above-named States, calling attention to the cause of the development of the fungus on tobacco, recommending the temporary discontinuance of lime and carbonate of potash, and advising the use of acid phosphate to correct the alkalinity of the soil in the case of badly diseased fields. The results during the present season from this method of treatment have proved very satisfactory. One prominent grower in Connecticut treated 40 acres at the rate of 1,000 pounds of acid phosphate per acre and had a fine crop of tobacco on land that gave a very poor crop last year. On other fields where this method was not followed but where lime and carbonate of potash were applied as before, the crop was practically a failure.

EXPERIMENTS IN ELECTRO-CULTURE.—Much interest has been aroused by announcements in the popular press from time to time regarding the remarkable stimulation in the growth and yield of crops resulting from electrical treatment. One method which has been recommended consists in suspending an insulated network of wires above the growing crops and keeping this network highly charged with positive electricity by means of a frictional machine or other device. The subject has been under investigation during the past two years in cooperation with the Office of Plant Life History Investigations, and the results of the investigations so far fail to show any stimulation in growth or any increase in yield due to electrical treatment. Caution should be observed in considering the process from a commercial standpoint.

INVESTIGATIONS AND EXPERIMENTS IN THE SEMIARID WEST AND SOUTHWEST.

Mention has been made throughout this report of various incidental projects having to do with the establishment of profitable agriculture in the arid or semiarid portions of the United States. In addition to these isolated or cooperative problems, the Bureau of Plant Industry has three branches, or offices, which are concerned wholly with the upbuilding of agriculture in those sections. These three lines of work are designated as Dry-Land Agriculture Investigations, Western Agricultural Extension, and Alkali and Drought Resistant Plant Breeding Investigations, respectively. A brief statement of the progress made during the past fiscal year follows:

DRY-LAND AGRICULTURE INVESTIGATIONS.

The work of dry-land agriculture investigations, with Mr. E. C. Chilcott as Agriculturist in Charge, has developed during the past fiscal year along substantially the lines described in former reports. No new stations have been established, but the work at the stations already established has been developed, their organization improved, buildings erected, land broken and subdued, additional equipment secured, cooperation with other officers of this Bureau and other Bureaus effected, and, in short, the investigations have passed from the preliminary stage of establishment into the productive stage. Some exceedingly interesting results have been obtained during the present season having direct bearing upon the most vital problems of agricultural development in the semiarid regions. Now that these results have begun to come in they will increase rapidlv both in quantity and in value from year to year.

COOPERATIVE RELATIONS.—The success of the correlation of the work of this office with that of other offices of the Bureau has been particularly gratifying, and with a few minor exceptions, the cooperation with the State agricultural experiment stations has been very satisfactory. The organization of the Cooperative Experiment Association of the Great Plains Area, which was effected in the fall of 1905 for the purpose of bringing about a closer relation between the officers of the various experiment stations of the Great Plains area and of the United States Department of Agriculture who are engaged in investigations upon the various problems of dry-land agriculture, has proved a very effective agent for the purpose for which it was organized.

Mr. Chilcott has been secretary of this organization from its beginning. There has been a good attendance and much interest shown at all of the four meetings held. The proceedings of the Manhattan meeting of 1907 have been issued as a bulletin of the Bureau of Plant Industry.

Another organization which has been very effective in bringing the work of these offices into more intimate relation with the problems of dry-land agriculture throughout the entire semiarid portion of the United States is the Trans-Missouri Dry Farming Congress, which was organized in Denver in January, 1907, and with which organization this Bureau has been closely identified from its inception. The second meeting of this organization was held at Salt Lake City, Utah, in January, 1908.

Bulletins dealing with dry-land agriculture problems are also issued at frequent intervals, all being first submitted to Mr. Chilcott for his approval before publication. This has resulted in placing the work of this office permanently before the people of the United States interested in the subject.

APPOINTMENT OF TRAVELING FIELD ASSISTANT.—The appointment of Mr. John S. Cole as general field assistant on April 1, 1908, has been a distinct gain to the effectiveness of the organization. Mr. Cole's duties require him to spend his entire time during the growing season in visiting the various substations in the Great Plains area where work of this office is being carried on and the farming communities adjacent to them, making detailed weekly reports to the Washington office. In this way he is able to bring about a close relation between the investigational work carried on at these stations and the practical farmers who are engaged in agriculture throughout the Great Plains.

UTILIZATION OF RESULTS ACHIEVED.—With these various means of disseminating the information obtained from the carefully conducted scientific experiments at the stations and for obtaining the most reliable information as to the actual agricultural conditions and problems existing in the area, it is believed that the results of the investigations in dry-land agriculture will be brought home to the actual settlers in this area in a most effective manner. Valuable data are being rapidly accumulated in the Office of Dry-Land Agriculture Investigations and in the other affiliated offices of this Bureau, the analysis and publication of which will soon become an important feature of the work. It will therefore soon be necessary to materially increase the office force to keep pace with the field investigations. If additional funds were available for the purpose a considerable number of new field stations could profitably be established, but it is believed that the most urgent present demand of the office is for the development of the field work already begun and the analysis, interpretation, and publication of the results that are rapidly being obtained from the independent stations already established at Amarillo and Dalhart, Tex., Akron, Colo., and Bellefourche, S. Dak., and the cooperative stations at Garden City and Hays, Kans., North Platte, Nebr., Edgeley, Dickinson, and Williston, N. Dak., and Judith Basin, Mont.

ORGANIZATION OF THE WORK.—In addition to the agriculturist in charge and the traveling field assistant, the scientific force of the office includes Messsrs. C. A. Jensen, J. E. Payne, F. L. Kennard, J. M.

Stephens, O. J. Grace, E. F. Chilcott, W. W. Burr, L. E. Hazen, and H. R. Reed, each of these men being located at one of the stations just mentioned. Two more special agents will soon be appointed for Amarillo, Tex., and Williston, N. Dak., respectively, and another traveling field assistant should be secured as soon as a man qualified for the position can be found. All of these men spend the winter months in the Washington office, working upon the results of their field investigations.

Active cooperative field work is now being carried on with nine of the offices of the Bureau of Plant Industry; with the Bureaus of Soils and Chemistry and the Forest Service, of the Department of Agriculture; with the Reclamation Service, United States Department of the Interior; and with the State agricultural experiment stations of Montana, North Dakota, Nebraska, Kansas, and Colorado.

WESTERN AGRICULTURAL EXTENSION.

The work of the Office of Western Agricultural Extension, of which Mr. C. S. Scofield is Agriculturist in Charge, has been directed during the past year to perfecting the organization and equipment for experimental work at the field stations already established by this office. These stations, with the exception of the one at San Antonio, Tex., are located on reclamation projects, where the land, water, and permanent equipment are furnished free of charge by the Reclamation Service. The primary aim of these field stations is to provide facilities for conducting experimental work with crops and tillage methods and to be of use to such special investigators of the Bureau of Plant Industry as are working on crops or crop problems that are applicable to the regions represented. In this way a very considerable economy of effort and of expenditure is secured.

Following is a brief statement regarding each of the field stations operated during the past year:

The San Antonio, Tex., experiment farm.—The work at the San Antonio experiment farm during the past year has been under the supervision of Mr. Stephen H. Hastings, Farm Superintendent. There are about 80 acres of land under cultivation on the farm. Experimental work has been carried on for seven cooperative offices in the Bureau. An elaborate series of rotation experiments has been inaugurated. Excellent crops of corn and cotton have been produced as a result of good tillage methods. The total eradication of Johnson grass has been accomplished in fields that were completely infested, and careful records of the labor involved show that this eradication may be accomplished at a cost of less than $1.25 per acre.

About 10 acres of land on the farm are devoted to experiments with horticultural crops, chiefly tree fruits. About 400 Mexican seedling peaches have been brought into bearing in the third year of their growth, and among these are five or six individuals with fruit of fair size and excellent quality. The standard varieties of peaches are not suited to San Antonio conditions, in part because of the high lime content of the soil and in part because they are susceptible to periods of warm weather in early winter and break into flower prematurely, a fault which the Mexican seedlings do not share.

THE YUMA, ARIZ., EXPERIMENT FARM.—The work at Yuma, Ariz., has continued during the past year under the direction of Mr. William A. Peterson, Farm Superintendent. The highly successful yields secured in connection with our previous experiments with Egyptian cotton have appeared to justify considerable emphasis on that portion of our work during the past year. The work with Egyptian cotton has been conducted in cooperation with Mr. T. H. Kearney, Physiologist in Charge of Alkali and Drought Resistant Plant Breeding Investigations, and will be referred to in greater detail farther on in this report.

In order to anticipate the problems that may arise in connection with the establishment of this new industry, it has been necessary to take up the question of determining the best crops to be grown in rotation with cotton, and also to investigate the subject of marketing this crop here in the United States. These lines of work are both well under way, and there now seems good reason for believing that Egyptian cotton may be profitably grown in the Southwest, that suitable crops may be found to grow in rotation with it, and that the fiber may be marketed at a price that will yield a fair profit to the producer.

The experimental farm at Yuma is one of the two field stations so far established by this Bureau in cooperation with the Reclamation Service, and the work is conducted on the Yuma Reclamation Service project.

THE FALLON, NEV., EXPERIMENT FARM.—The Fallon experiment farm is located on the Truckee-Carson project of the Reclamation Service. The farm includes 160 acres of land, a part of which is of a type known locally as heavy or "hard" land, which is not uncommon on the project. This type of soil has been found very difficult to bring into production, owing to its peculiar physical nature and to its lack of humus. Persistent tillage and irrigation, together with the use of barnyard manure, have resulted in a material improvement of this soil, and much of it is now in crops. During the year about 20 acres of the sandy land of the farm have been leveled and put into crops, making 35 acres in all now under irrigation. Experimental work is being carried on for six offices in the Bureau, and also with the Forest Service. Cooperative relations have been established with the horticultural department of the Nevada Agricultural Experiment Station, and considerable plantings of horticultural crops have been made on the experiment farm, the material for which was furnished by the horticulturist of the State station.

An experimental planting of 19 varieties of sugar beets, made last season in cooperation with the Office of Sugar-Beet Investigations, gave very promising results. Thirteen of the varieties yielded 20 per cent or over of sugar in the juice, and the purity of the juice was also high.

In view of the intense aridity of this region and other rather unusual climatic conditions, and also because it is new agriculturally, it has been deemed advisable, as a preliminary step, to try out a large number of different crops. From the results of these trials we are now able to select a number of crops that are sure to succeed, and with these crops we are now prepared to begin experiments in tillage and rotation methods.

ALKALI AND DROUGHT RESISTANT PLANT BREEDING INVESTIGATIONS.

The alkali and drought resistant plant breeding investigations are under the immediate direction of Mr. T. H. Kearney, Physiologist, assisted by Dr. H. L. Shantz and Mr. A. C. Dillman.

EGYPTIAN COTTON IN THE SOUTHWEST.—During the past ten years the United States has imported from Egypt an average of 54,000,000 pounds of cotton annually. In 1907 the total value of the imports was over $16,000,000, and the average price per pound paid at Boston for this cotton was 21.9 cents. In view of the great value of this import, a special effort is being made to establish Egyptian cotton culture under irrigation in southern Arizona and southeastern California, the portion of the United States where it gives the best indication of success.

Much progress was shown last season (1907) in the acclimatization of Egyptian cotton in the Southwest. At Yuma, Ariz., the strain developed by five years of selection from imported seed of the Mit Afifi variety yielded at the rate of 2 American bales per acre. The bolls opened better and the cotton matured earlier than in any previous year. The quality of the fiber also showed a distinct improvement, averaging nearly 1½ inches long in the experimental field of 4 acres. The strength and fineness of the lint were highly satisfactory. Unselected samples of the bulk crop at Yuma were submitted to 22 American buyers and manufacturers of Egyptian cotton, of whom 18 reported as to the quality and 11 furnished estimates of the value at current prices (from February 15 to March 7, 1908). The average of the 11 prices quoted was 20.6 cents at a time when American middling Upland was selling on the Boston market at from 12 to 12½ cents per pound. Four lots of 200 pounds each of the 1907 fiber have been shipped to eastern manufacturers, who have agreed to furnish a spinning test.

During the present season (1908) about 40 acres of Egyptian cotton are being grown in Arizona, of which 5 acres are situated on the experimental farm conducted by the Office of Western Agricultural Extension in cooperation with the United States Reclamation Service at Yuma, Ariz., and 20 acres are located on the Pima Indian Reservation, at Sacaton, Ariz., where the cotton is being grown under the direction of the Office of Plant Life History Investigations in cooperation with the Indian Office. The remainder of the acreage is being grown by individual farmers, chiefly in the Salt River Valley in Arizona. Recent reports promise a sufficiently large return from the total acreage to permit of a satisfactory marketing test. Plans are being perfected to market this cotton under conditions that will give a satisfactory indication of what net returns can be expected from the crop when grown in the Southwest.

During the coming season it is planned to distribute a considerable quantity of seed of acclimated Egyptian cotton to the farmers in those portions of the Southwest where it is believed this crop will be most successful. Breeding work with Egyptian cotton will be continued at Yuma in order to preserve the high quality that has been attained, and also in order to secure further improvement in some of the characteristics, notably the luster, color, and uniformity of the fiber.

ALKALI-RESISTANT CROP PLANTS.—Work in testing the alkali resistance of a series of field-crop plants, especially forage plants, is being continued at the North Platte substation, in cooperation with the Nebraska Agricultural Experiment Station; at Fallon, Nev., and Yuma, Ariz., in cooperation with the Office of Western Agricultural Extension; and on the Pima Indian Reservation, at Sacaton, Ariz., in cooperation with the Office of Plant Life History Investigations and the Indian Office. At Sacaton the alkali resistance of Egyptian cotton and of the pomegranate is being given special attention. In cooperation with the Office of Sugar-Beet Investigations, the work in breeding alkali-resistant sugar beets is being continued at North Platte, Nebr., at Fallon, Nev., and at Corinne, Utah. In addition to this testing and breeding work, investigations are under way on different methods of irrigation and tillage, in order to ascertain how best to handle different crops on alkali soil.

The results with forage plants in the main confirm those of the previous year. The following species can now be recommended for soils containing considerably more alkali than will allow a good stand of alfalfa to be obtained: Rape, kale, western wheat-grass, smooth brome-grass, tall meadow oat-grass, Italian rye-grass, tall meadow fescue, and millets (both foxtail and proso). Several other meadow grasses, notably orchard grass and slender wheat-grass, show considerable resistance. Of the leguminous crops tested, the horse bean, sweet clover, hairy vetch, scarlet vetch, and Canada field peas have been found fairly resistant, and in about the order named. Of the sorghums so far tested kafir appears to be the most promising, but further investigations are necessary to settle this point.

Next season it is proposed, in cooperation with the Office of Western Agricultural Extension, to extend the investigations of the best methods of seeding, irrigating, and tilling different crop plants on alkali soils.

BREEDING DROUGHT-RESISTANT CROP PLANTS.—Mr. Arthur C. Dillman, a graduate of the South Dakota Agricultural College, was appointed on February 17, 1908, to take immediate charge of the work in breeding plants for drought resistance in the northern part of the Great Plains area. The work was started at Bellefourche, S. Dak., this spring with a number of forage plants, especially some of the most promising selections of alfalfa and foxtail millets which had been developed at Highmore, S. Dak.

It is proposed next season to extend the breeding work at Bellefourche, introducing a much larger series of grasses and leguminous forage plants. Attention will be especially directed to securing a thoroughly hardy and drought-resistant strain of alfalfa for growing without irrigation in the northern part of the Great Plains area and to developing a drought-resistant annual leguminous crop which can be used in short rotations in that region. It is also planned to take up this line of work at the substation at Akron, Colo.

LIFE HISTORY AND BREEDING OF POMEGRANATES.—In cooperation with the offices of Plant Life History Investigations and of Foreign Seed and Plant Introduction, work has commenced in securing varieties of pomegranates suitable for growing in the United States, especially in the Southwest. The most valuable varieties grown in different parts of the Old World are being introduced and collections are being started at the experimental farms at Indio, Cal., Sacaton and Yuma, Ariz., and San Antonio, Tex. During the past winter over 1,000 seedlings of Spanish origin were grown in the greenhouses at Washington and will be sent out this fall chiefly to the four stations named, in the belief that from a sufficiently large number of seedlings new and valuable varieties can be selected.

INDICATOR VALUE OF THE NATIVE VEGETATION.—Dr. H. L. Shantz, lately professor of botany at the University of Louisiana, was appointed, on April 27, 1908, to investigate the relations between the native vegetation and the physical environment in the Great Plains area. During the season of 1907 Doctor Shantz, serving as a special agent of the Bureau, made a detailed study of the natural vegetation in the vicinity of Akron, Yuma, and Wray, eastern Colorado. Some of his more important conclusions are as follows:

Transpiration from plants and evaporation from the soil, after the latter had become fairly dry, were found to be usually inversely proportional to the evaporation from an evaporimeter. Soil-moisture determinations in prairie sod and in cornfields on the so-called "hard lands" showed that cultivation greatly increased the water content of the soil, while on the sandhills the water content is no greater in cultivated than in uncultivated land. The minimum amount of soil moisture permitting plants to live in a silty loam soil ("hard lands") was determined for a considerable number of species, both wild and cultivated. A preliminary study was made of the structural peculiarities of the native species that proved most resistant to drought.

During the present summer (1908) Doctor Shantz has visited all the experimental substations in the area and has made a study of the native vegetation in the vicinity of each, as well as general observations on the vegetation of all parts of the area traversed, the ultimate object being a survey of the native vegetation of the entire area in connection with the physical conditions and agricultural possibilities that characterize different parts of it. During the remainder of this season Doctor Shantz will devote his time to the study of the vegetation at some one locality in the area, giving especial attention to the structural and physiological characteristics of those species which are most valuable as indicators of the amount and distribution of moisture in the soil.

PHYSIOLOGY OF ALKALI AND DROUGHT RESISTANCE.—An investigation was completed by Mr. L. L. Harter, lately of this office, on the effect of a mixture of alkali salts, chiefly sodium chlorid, on the leaf structure and transpiration of wheat, oats, and barley. It was shown that the salts induced a thickening of the cuticle and a reduction in the size of the cavities of the epidermis cells and also a conspicuous deposit of wax on the surface of the leaves. The greater the concentration of the salts the more marked were the morphological changes. In this respect the effect of alkali is very similar to that of a reduction in the water supply, indicating a close affinity between alkali resistance and drought resistance. Amounts of alkali salts sufficient to produce a noticeable effect on the leaf structure caused a marked reduction in the transpiration, while much smaller amounts of salts appeared to stimulate transpiration.

During the present season a special study has been made in the alkali-resistance test plats at North Platte, Nebr., and Fallon, Nev., of the fluctuations in the amounts of alkali at different depths in the soil in connection with the movements of the soil moisture at the same depths. For this purpose borings have been made at fixed points at frequent intervals during the season. These observations, in connection with studies of the root development of the different species, are expected to yield more definite information than has hitherto been available as to the amount of alkali which the different varieties of plants can endure at different stages of their growth. The tests of the alkali resistance of different species to be carried on in the greenhouse will afford at the same time an excellent opportunity for careful study of the physiological effects of different amounts and types of alkali upon different species of crop plants.

SOIL-BINDING PLANTS FOR DITCHES AND CANALS.—In cooperation with the Office of Forage Crop Investigations and with the United States Reclamation Service, investigations are being carried on at Bellefourche, S. Dak., and at Fallon, Nev., of different species of plants most suitable for holding the banks of irrigating canals and ditches. Mr. A. C. Dillman has immediate charge of the work at Bellefourche. The problem promises to be a difficult one, since for the tops of the banks, species having a considerable degree of drought resistance will be needed, and in many cases alkali resistance is a further requirement. Results so far obtained with grasses indicate that western wheat-grass and smooth brome-grass are the most promising for the dry summits and outer slopes of the banks, while redtop gives excellent results on the inner slopes near the water line.

DEMONSTRATIONS AND EXPERIMENTS WITH FIELD CROPS.

Many of the projects of the Bureau of Plant Industry are grouped together on the crop basis, especially those dealing with the adaptation and breeding of field crops—cereals, cotton, corn, tobacco, sugar beets, etc. The work of the Bureau along these lines during the past fiscal year is briefly set forth in the following:

GRAIN INVESTIGATIONS.

The most important work of the Office of Grain Investigations, under the immediate direction of Mr. M. A. Carleton, Cerealist, during the past fiscal year has been conducted approximately along the following lines:

BARLEY CULTURE IN THE NORTHERN GREAT PLAINS.—During the year there was considerable demand for some printed information on barley cultivation, particularly in the northern Great Plains States. For about eight years this office had been experimenting with many kinds of barley and different methods of cultivation in cooperation with the State agricultural experiment stations, and special attention had been given to the matter in South Dakota, but no publication of the results of these experiments had been made by this Bureau. A careful comparison of the results of the different years' work in several States enabled some interesting conclusions to be drawn. We find that there are two rather distinct barley districts in the Northern States with respect to the varieties best adapted for cultivation in those districts, the two-rowed barleys being found best adapted to the district of the northern Great Plains west of the Red River of the

North, while the six-rowed barleys give best results in the district east of that river, including Minnesota, Wisconsin, and adjacent portions of Iowa and Michigan. As this conclusion is derived from an average of many years' results, it should be considered as fairly accurate.

Winter barley.—Further successful investigations have been continued on a somewhat broader scale with this important winter grain, the best variety still being the Tennessee Winter. In addition to the region of Kansas and adjacent portions of Missouri, Nebraska, and Oklahoma, winter barley has now been tried at a number of points in other States, particularly Indiana, Illinois, and Ohio, and has usually been successful. The yield per acre continues to be much better than that of spring barley grown in the same locality. A particularly interesting feature of recent trials of winter barley has been the comparison of drilling and broadcasting the seed. As the particular problem is to overcome the winter cold, naturally the method of drilling has always been more successful. Only about one-third as many failures have resulted from growing winter barley drilled as in cases where it was broadcasted. Several other varieties are still under experiment, some of which give promise of considerable hardiness.

Kharkof wheat.—The Kharkof strain of the Crimean or Turkey hard winter group of wheats has been still more widely grown the past year, not only in Kansas and Nebraska, but in Colorado, Wyoming, South Dakota, Iowa, and portions of North Dakota, Minnesota, and Wisconsin. In all trials of various winter wheats on State experimental farms in Wisconsin the Kharkof did much better than other varieties, which included two or three other hardy strains from Russia. An important conclusion derived from several years' experiments with this wheat is that it is particularly hardy in cold districts which are at the same time also dry—that is, it is rather remarkable in its resistance to a combination of drought and cold. This is of particular advantage in permitting a considerable increase of the winter-wheat area toward the west as well as the north. Other varieties do not resist the dry winter winds.

Winter oats.—In addition to the Snoma winter oat several other varieties have been under experiment for several years, and some of these by further breeding are likely to be of much importance; for example, hardy winter strains are being developed from the well-known Dun oat from Scotland and from the pedigree variety known as Swedish Select. The Snoma, however, continues to be the hardiest variety, followed closely by the Culberson as second best. By sowing oats in corn stubble it was found possible in one instance to carry the crop through a rather severe winter in southwestern Nebraska.

Durum wheat.—Some very interesting things were learned from the experiences with durum wheat during the year. The total production of the crop of 1907 appears to have been somewhere between 45,000,000 and 50,000,000 bushels, very nearly the same as the production of the year before. Somewhere near 25,000,000 bushels were exported. There continued to be a considerable foreign demand all through the winter, and even at this date the wheat is being exported practically as fast as it can be obtained in sufficient quantities for shipment. The operations of the year have witnessed some rather new enterprises with respect to the utilization of this wheat. A large milling firm has used one mill entirely for grinding durum wheat and has put out a patent durum flour, while another mill has launched into an extensive production of durum wheat semolina for macaroni manufacture. Several rather extensive tests, all fairly successful, have also been made during the year by prominent bakers in the use of durum wheat flour for bread.

From the experiences of several years with durum wheat the inference seems justified that for best success commercially it is necessary to develop two rather distinct varieties of this group, one of the well-known Kubanka, or Arnautka, type, already largely grown in North and South Dakota and by far the best of the durum type for bread flour, and another of the varieties Saragolla, or Pellissier, or some similar strain coming originally from Italy or Algeria and adapted to our southwestern plains and which would probably be best for macaroni production. There is yet to be developed a satisfactory type of the latter character, suitable for macaroni making, which will be thoroughly adapted to the southern plains.

From the agricultural standpoint the chief line of investigation during the year has been a very thorough comparison of dozens of the best varieties of this wheat. A number of these are being grown from single mother plants and are now being developed as perfectly pure strains. Efforts will be made to get into the hands of farmers as soon as possible pure seed of the variety that proves best under these comparisons.

GRAIN SORGHUMS.—In this line of work a special study has been made of the extent to which grain sorghums are used for stock foods, which has led to some rather surprising results. It is found that sorghums are used in the various stock foods of the country to a very much larger extent than is generally supposed. A particularly large quantity, especially of kafir, is used in the many kinds of poultry foods, even in those manufactured in the Eastern States. These facts show still further the importance of the cultivation of grain sorghums, for while they are particularly adapted to the semiarid western districts there is nevertheless thus shown to be a very considerable market for them among eastern manufacturers.

Investigations have been continued for the development of strains of kafir and milo having a shorter growing period, and experiments and demonstrations with these two crops have been made still farther to the north and west than during the preceding year, with considerable success. A special effort is being made to bring to the attention of farmers the importance of milo as a crop for grain production in the drier districts, and a Farmers' Bulletin on the subject has been issued. In the spring of 1908 cooperative trials of milo and kafir were instituted on farms in nearly every county of western Kansas and adjacent portions of Oklahoma and Colorado. Arrangements have been made to cooperate with the Bureau of Entomology in a further investigation of the sterility of sorghums and methods for preventing the damage done in this way by the sorghum midge.

EMMER AND SPELT.—Still further important results have been obtained in an effort to extend the use of the Black Winter emmer as a crop for stock food on dry lands. A considerable amount of seed of this emmer has now been produced at several different points, but not sufficient for very general distribution. A decided advantage in the cultivation of winter emmer is that while being particularly resistant to drought and cold it is a very hardy crop for almost any condition, and therefore is of wide adaptation.

It is found by this time that the Red Winter spelt is also likely to be of importance as a hardy crop for stock feeding. Winter spelt continues to be very successful in surviving the hardest winters on experimental farms in the West and North, and it has been found recently that this grain has been grown successfully as a winter crop for several years in a single locality in Michigan, which fact will be made use of in future work with this cereal.

PACIFIC COAST EXPERIMENTS.—In addition to the confirmation of results reported the year before, showing the effect of our experiments in California on general crop management and methods of harvesting in that State, there are other features of importance. The Chul and Fretes wheats continue to give good returns per acre and in other respects show themselves to be fairly well adapted to that State. With the grain obtained from these varieties in the present harvest it is expected to make milling and baking tests. In the driest portions of the State the durum wheats continue to give very good results compared with other varieties both in agricultural adaptation and maintenance of good protein product.

A so-called "triangular experiment" that has been conducted for two years (the present season being the third), in which exchanges of seed of two important wheats have been made between California, Kansas, and South Dakota, has shown so far that either a hard winter or a durum wheat will always give a low protein content in California, whether from seed grown there before or from seed imported from other States where the gluten content is high. This is extremely important in connection with the efforts to establish a more glutinous wheat in that State.

Some investigations, including actual trials, have indicated that the cultivation of grain sorghums in many parts of Califronia, particularly the southern portion, is likely to be followed with much success, provided especially that well-adapted varieties are grown, and a considerable extension of work in this line is now under way.

AMARILLO, TEX., EXPERIMENTAL FARM.—One of the important conclusions to be derived from four years' work in the Texas Panhandle, including two years on this experimental farm, is that comparatively low rates of seeding are always best for the grains. The results so far indicate that about 3 pecks per acre are best for hard winter wheat, 5 or 6 pecks for durum wheat, and about 6 pecks for oats. Barleys, at least spring varieties, seem poorly adapted to the country, and rate-of-seeding tests for this grain have not been satisfactory. The results of two years' work at Amarillo seem to show that a much wider space between drill rows should be allowed in wheat seeding than is usually the practice anywhere in that region. Another year's work confirms some very important results previously obtained showing the advantage of using home-grown seed in small-grain crops. There is an increase each time of 50 to 100 per cent in yield per acre in favor of the home-grown seed. Favorable results are still being obtained in the efforts to develop short-season kafirs and dwarf milo with erect heads.

Dry-land cereals.—More attention than formerly is being given to the work of dry-land cereal investigations. During the past year work has been started at six different stations located in representative sections of the Great Plains and intermountain areas, as follows: Williston, N. Dak.; Bellefourche, S. Dak.; Akron, Colo.; Dalhart, Tex.; Nephi, Utah; and in the Judith Basin, Mont. Large numbers of varieties of grain are being tested at these stations for their hardiness and drought resistance. While only one year's results have been secured many new varieties introduced have outyielded ordinary sorts from 20 to 50 per cent. Improvement in the quality of dry-land grains is also being kept in mind. Individual plant selections are being made, looking toward the development of a better milling wheat as well as one of a high yielding quality.

Special attention is being given to the production of hardy winter strains. This year winter wheat has been grown at all of these stations except Williston, N. Dak. Even on the plains of Colorado and western South Dakota wheat came through the winter in good shape and exceeded the yield of spring varieties in almost every instance. Hardy winter varieties of barley and oats have been found for the intermountain States, their yield being much larger than that of the best spring varieties. Experiments are under way for solving the important question whether summer fallow is absolutely necessary for successful dry-land farming, a number of rotations being in operation for giving results in comparison with summer fallow. Two circulars bearing directly on the work of dry-land cereal production have been issued during the year.

Rice investigations.—The work of the year on the cooperative rice experimental farm at Crowley, La., has furnished some important results in addition to the numerous tests of varieties and tests with different fertilizers and methods of watering, which latter require several years' work to obtain reliable information. A study was made on this farm of the manner and time of opening of the rice flower, which will be of much value in aiding all future work in the cross-breeding of rice. It was found that only at a certain time during the forenoon is it possible to perform satisfactory cross-pollination, as it is only at this time that the flower is in condition to facilitate these operations. These investigations were made by a Chinese student, Mr. Yau Hang Tong, working in collaboration with this Bureau. During the year, also, a classification of the known varieties of rice was prepared, which will be of use in the future investigations of this office. Mr. Charles E. Chambliss was recently appointed Expert in Charge of Rice Investigations. In addition to the work conducted in Louisiana, Texas, and South Carolina, considerable time is now being given to the study of the possibilities of rice culture in California, where attempts to grow rice have already been made in several localities with apparent success.

Cereal diseases.—Considerable time has been given to a study of the grain sorghum smuts, and a satisfactory treatment for the grain smut of these plants has been worked out and published in Circular No. 8 of this Bureau. On the other hand, the head-smut is found to be similar in its life history to the loose smuts of wheat and barley, which have increased rapidly in the Northwest in recent years, and there are already data at hand for furnishing a much better treatment for these smuts than has been known heretofore. Excellent results have already been obtained in the case of loose-smuts of wheat and barley in Kansas and Minnesota by men working under the direction of this office.

In the study of cereal rusts it has been demonstrated that both the black stem-rust and the orange leaf-rust winter over in the uredo stage as far north as the vicinity of St. Paul, Minn., this being accomplished through the form of this rust found on the native grasses. Further information has been obtained concerning the relationship of cereal and grass rusts, which will be of importance in efforts to combat the former. Much information is being obtained on the comparative rust resistance of different varieties of grain by artificially producing the rust and then keeping the plants under conditions favorable to rust propagation. In this way the facts concerning rust resistance are more easily and quickly obtained. An investigation has been made of the possibility of disinfecting farm machinery, with results that already indicate that crusades against bunt or stinking smut of wheat may be conducted in future on a large scale over considerable territory.

Effect of environment on grain composition.—Under "Pacific Coast Experiments" mention has already been made of the "triangular experiments." Arrangements have been made during the year to conduct, in connection with these experiments, an exchange of soils between the Arlington Experimental Farm, in Virginia, and points in Kansas and California, it being the purpose to determine, as a result of growing the grains on other soils in the same State, how far the nature of the soil itself is concerned in the deterioration of wheat in gluten content. This work is in cooperation with other offices of this Bureau and with the Bureau of Chemistry. Analyses of samples of the same variety of wheat received from different parts of the country the same season have shown a great variation in the nitrogenous content, although the crops were grown from the same seed of the year before.

Food value of grain.—Considerable additional work has been done in this line during the year and a report on the subject is now ready for publication, the work being done in cooperation with the Bureau of Chemistry. A special study has been made of numerous introduced varieties of barley and rice. In the work with barleys a great variation has been found in the protein content of different varieties.

Plans for the ensuing fiscal year.—During the ensuing fiscal year considerable time will be devoted to the development of hardier and shorter season varieties of cereals for high altitudes in intermountain districts, particularly barleys, oats, and spring wheats. A special study will be made of beardless barley, looking toward its improvement, as this crop is well adapted to intermountain areas and is probably the best of the cereals for a hay crop.

Investigations will be continued for the purpose of determining the best variety of durum wheat for the southwestern plains that will be adapted for the manufacture of macaroni; also the production of hardier winter durums. Selections for the improvement of individual strains will be made, and also an investigation of methods of seeding. In cooperation with the department of chemistry of the North Dakota Agricultural Experiment Station a further study will be made of the comparative food value of durum wheat through numerous milling and baking tests.

In cereal-disease work, investigations will be continued for the determinations of the most practical methods of disinfecting thrashing machines for the prevention of bunt. A further study will be made of sorghum smuts and of the life history of cereal rusts and rust resistance of wheat varieties; and the investigation of wheat scab already begun will be continued.

In rice investigations, in addition to the work, already mentioned, being conducted in Louisiana, Texas, and South Carolina, further special attention will be given to the conditions in California with reference to rice growing in that State. In Louisiana more time will be given than heretofore to methods of rice cultivation. In grain-sorghum investigations special attention will be given, in addition to other work, to a further study of the commercial uses of these sorghums. Adaptation experiments with different kinds of buckwheat and proso (Russian millet) have already been undertaken and will be given more attention the coming year. Further efforts will be made to increase the hardiness of winter wheat and winter oats, and particularly to produce a winter durum variety.

More extensive trials will be made with Black Winter emmer as a stock food, and special attention will be given to the development of a good strain of winter spelt adapted to northern and western districts. On the various grain experimental farms it is arranged to conduct thorough experiments on different rates of seeding and seeding at different dates, which experiments will be uniform at the various farms.

BIONOMIC INVESTIGATIONS OF COTTON AND CORN.

The bionomic investigations of the Bureau have been concentrated during the past year on the two principal crops under investigation—cotton and corn. Other tropical crops have received attention in an incidental way. These investigations are in charge of Mr. O. F. Cook, Bionomist, assisted by Mr. G. N. Collins. The field experiments with weevil-resisting cotton varieties are conducted by Mr. F. L. Lewton, and studies of corn varieties in tropical America are being made by Prof. H. Pittier.

The object of the Bionomic Investigations is to apply the principles of evolution and adaptation to the solution of agricultural problems and to learn how plants are adapted to special purposes and conditions of existence and increased in agricultural value. Particular attention is being given to adaptive characters and environmental reactions of corn and cotton in order to improve these crops, to give them increased protection against insect enemies, and to extend the areas of cultivation.

Weevil-resisting adaptations of cotton.—Experiments during the season of 1907 continued to add to the evidence that definite weevil-resisting adaptations exist in the varieties of cotton from the Central American region. Firmly closed, hairy bracts exclude the weevils from the young buds. Large proportions of the eggs of the weevils are destroyed by vigorous growths of wound tissue (proliferation) inside the buds and bolls. The greater fertility of the lower branches conduces to the early production of the crop and conceals many of the buds and bolls from the weevils, whose instincts lead them to climb to the upper part of the plant. Many of the imported varieties excel our Upland cottons in resistance to drought, and may enable cotton culture to be extended into the drier regions of the Southwest, where the weevils can do very little damage.

ACCLIMATIZATION OF WEEVIL-RESISTANT COTTONS.—The work of acclimatizing cotton varieties has been continued since the last report. It has been found that in the third generation some of the strains returned to normal habits of growth and fertility, though still lacking the necessary uniformity in the characters of the bolls and lint. Field tests on a commercial scale are not yet practicable, but it is already evident that some of the weevil-resistant types possess excellent agricultural and commercial qualities.

LOCAL ADJUSTMENT OF COTTON VARIETIES.—That the disturbance of the normal characters of varieties by transfer to new conditions is not confined to the recently imported Central American cottons has been shown by experiments with a series of standard Upland varieties. Distinct differences in uniformity are often found in different plantings from the same lot of seeds, depending on whether they were planted in the place where the seed was grown or in another and somewhat different place. Moreover, these differences are large enough to have decided practical importance. The second generation often had an advantage of between 10 and 20 per cent over a new planting from the same original stock of seed. Notable differences in habits of growth were also shown under different conditions. Thus, all the plants of several different selections of the Parker cotton grown at Del Rio, Tex., in 1907 assumed a distinct semicluster habit of growth, while in other localities the plants raised from the same lots of seeds retained the long fruiting branches characteristic of the variety.

A NEW STANDARD OF SELECTION IN COTTON.—Crops may be injured, instead of being improved, if bred by wrong standards of selection. The use of the lint percentage as one of the chief standards of selection in cotton has a dangerous tendency to decrease the size of the seeds instead of increasing the amount of lint. The lint percentage represents the proportion of lint in a sample of unginned cotton. If the seeds are small the percentage may be high, even in a relatively unproductive variety. Small-seeded varieties also tend to have smaller bolls and fewer seeds in the bolls. Small bolls are undesirable because they increase the labor of picking, and small seeds because they mean smaller and weaker seedlings.

Our studies have led to the publication of a circular recommending that selections be made on the basis of the quantity of lint produced by 100 seeds instead of by the percentage of lint. The weight of the lint of 100 seeds, expressed in grams, is to be called the lint index. The practical difference between the lint index and the lint percentage is often considerable. A hundred seeds with a high lint percentage may have only seven-eighths as much lint as an equal number with a high lint index.

MEXICAN BIG-BOLL COTTONS.—Some of the Mexican varieties of cotton have very interesting features, though lacking the definite weevil-resisting adaptations of the Guatemalan cottons. Varieties from southern Mexico have distinctly larger bolls and more lint than any of our Upland sorts. As big-boll cottons are coming more and more into favor, because less labor is required in the picking, these Mexican big-boll cottons are receiving careful attention. They have already shown themselves superior to most of our Upland cottons in the length and texture of the lint, and at the same time they are early and prolific. They are also responding to acclimatization somewhat more readily than the Guatemalan varieties.

THE WEEVIL-EATING KELEP.—Experiments with the kelep, conducted in cooperation with the Bureau of Entomology, have been brought to a conclusion. The kelep is an ant-like insect whose weevil-eating habits were discovered in Guatemala in 1904 in connection with the search for weevil-resistant varieties of cotton. The efficiency of the insect as a protector of cotton against the weevils was shown by field experiments in Guatemala in 1905, in which United States varieties were used as well as the native cotton. It was also ascertained that the insect has no habits likely to render it injurious or undesirable in this country. Methods of capturing and transporting the colonies were also worked out, and some hundreds of the colonies were imported.

Experiments in Texas showed that the insects are able to establish themselves in the cotton fields and that they can stand the cold of the winter, but the soil conditions are distinctly unfavorable. The keleps do not survive the occasional floods to which nearly all of the cotton lands of Texas are subject. The possibility remains that they might become permanently established in some of the drier and more sloping lands to the west of the prairies, but the areas of cotton land which they might occupy are very limited and because of their drier climate have relatively little need of special protection against the weevils.

SPECIALIZED VARIETIES OF CORN.—Corn is the principal crop plant in the New World and yields annually a product the farm value of which is one and one-third billions of dollars in the United States alone. Nevertheless, there are many regions where corn is not grown because of conditions which exclude our ordinary varieties. For such regions it may be possible to acclimatize and improve some of the races of corn which have become adapted to special conditions by centuries of culture in Central and South America, where corn is grown under a wider range of conditions than in the United States.

DROUGHT-RESISTANT VARIETIES OF CORN.—Our experiments with the drought-resisting varieties of corn from tropical America have shown that there are two very distinct types, each of which is adapted to special conditions and methods of culture. In one type the plants are small and produce only superficial roots. This type is adapted to regions where light rains fall during the growing period and there is no supply of water below the surface to be conserved by a system of dust mulching. The second type produces larger plants with very deep roots for drawing water from the lower layers of the soil.

CORN FOR IRRIGATED REGIONS.—In cooperation with the Office of Western Agricultural Extension, experiments are being conducted at Yuma, Ariz., and Fallon, Nev., with a view to securing varieties of corn that will thrive under irrigation. With the rapid reclamation of arid lands in the West the need of corn varieties adapted to such conditions is keenly felt. None of the varieties in common cultivation in the United States seem able to withstand the intense heat and excessive transpiration of the desert climates, but farther south in Mexico there are varieties which are regularly and successfully grown under irrigation. Acclimatization is as likely to be needed with these varieties as with others, but there is a distinctly better prospect of success.

COMPOSITE BREEDING OF CORN.—To test the possibilities of composite breeding as a practical method of securing desirable combinations of characters, mixed plantings of imported varieties of corn are being made in different parts of the United States. These composite plantings are giving us an endlessly diverse series of combinations of characters. It is to be expected that the most successful combinations will appear in the most fertile and vigorous plants, so that simple selection for vigor and productiveness may lead to the building up of the combinations which are best adapted to the conditions.

STUDIES OF EVOLUTION AS AN AID TO BREEDERS.—In view of the widespread interest in plant breeding and the almost incalculable importance of applying safe methods of breeding to our principal economic plants and animals, a bulletin has been prepared for publication on the nature and causes of evolution, with numerous applications to the practice of breeding. These studies have shown that theories and methods of narrow breeding, as commonly followed, are fallacious and are likely to result in a serious and perhaps irreparable deterioration of our domesticated species of plants and animals, our most valuable agricultural heritage. Before we leave behind the methods of breeding by which our forefathers have brought our domesticated species to their present degree of perfection, we should be sure that we are advancing to really higher ground, instead of taking reckless chances of permanent agricultural injury which posterity may be powerless to remedy. Artificial methods of agricultural breeding often depart widely from those by which the natural evolutionary improvement of plants and animals is accomplished. The members of natural species have much individual diversity, while uniformity is the usual object of agricultural breeding. The method of securing uniformity is to breed from a single individual or from as few as possible instead of from many lines of descent, which is the natural method.

COTTON-BREEDING INVESTIGATIONS.

The work of breeding cottons to meet boll-weevil conditions and to secure other desirable improvements has been continued along the same lines as set down in previous reports. This work is under the immediate direction of Mr. A. D. Shamel and Dr. D. N. Shoemaker. Various phases of the field work are under the immediate charge of Profs. S. M. Bain and D. A. Saunders and Mr. E. B. Boykin.

COOPERATIVE COTTON BREEDING.—Work in the cooperative breeding of cottons in Georgia is being conducted by Mr. Shamel, assisted by Mr. H. A. Allard. An exhaustive study of the cotton fields of the Piedmont region of northern Georgia in 1907 revealed the fact that most of the cotton fields produced a large proportion of inferior, light yielding, and barren plants. It was found that this condition was in a large measure responsible for the low yield and, in many cases, inferior quality of the cotton produced on these fields. After the most careful observation the conclusion was reached that these inferior and undesirable plants were produced from inferior, light, mixed, abnormal, and unproductive types of seed that could be eliminated by careful breeding and seed selection and by seed separation. On the basis of the yield of the productive plants in these fields the yield of lint per acre could be doubled by seed selection without much, if any, increase in the cost of the culture of the crops.

As a result of the interest aroused among cotton growers in this region during the course of this preliminary work, a series of cooperative tests of varieties of cotton adapted to the soil and climatic conditions of northern Georgia, and in this connection several breeding experiments with the growers, were undertaken in 1908. The object of the variety tests was to determine by careful comparative tests the value of the unimproved varieties in comparison with the profitableness of certain improved varieties developed by breeding and seed selection in other districts of the cotton belt, but which were thought to be wholly or in part adapted to the soil, climatic, and cultural conditions of this district. The results of these tests, conducted on a commercial scale, have been almost startling, arousing the greatest interest among the cotton growers all over Georgia, as evinced by their continued visits to these experimental fields.

DEMONSTRATIONS AMONG COTTON GROWERS.—In the breeding fields extensive tests were made of the productiveness of the best individual plants found in the cotton fields in 1907, with a view of propagating the best types of the established varieties. These fields were also demonstration fields, where it was found that the parent cotton seed plants, varying in number of bolls per plant from 1 to 185, and with an almost equal amount of variability in quality, length, strength, and quantity of lint, came true to seed. This striking demonstration served as a forceful illustration to growers of the necessity of planting only the seed from the best plants in the fields. In addition to these breeding experiments, others, such as the acclimatization of improved varieties by seed selection and the production of new and improved types by crossing both within and between varieties, were undertaken.

The conditions of the Piedmont region seem particularly adapted for producing sports and mutations in the origination of new and improved varieties of cotton adapted not only to this region but to other great districts in the eastern cotton belt.

PLAN OF COOPERATION WITH FARMERS.—The plan is to cooperate with farmers who are suitably located as regards soil and climatic conditions and who have the necessary facilities for this work. Expert advice and assistance in arranging breeding fields, making seed selections, and sowing and separating seed are given the growers by trained agents of this Bureau. The necessary records and other matters of this character are kept by the growers under the direction of these agents. These fields serve as centers of popular interest in their respective localities, to which visitors are always welcomed and to whom the work is explained and discussed.

A direct result of this work has been the organization of the Georgia Cotton and Corn Breeders' Association, made up for the most part of the cooperators in this work. Its object is the mutual help and intercourse so necessary to the carrying out of this project on the far-reaching scale anticipated. It is planned to carry this work into all of the cotton-growing districts of the cotton belt as rapidly as popular interest demands and funds will permit.

Breeding cottons for South Carolina.—The work in South Carolina has had the direct result of influencing farmers to begin the selection of cotton on their own account. In addition to the breeding work, tests of fertilizers, of the effect on lint of holding cotton in the seed, and of the use of vetch as a cover crop for cotton have been made during the year. This work is making satisfactory progress and a part of it will be completed during the coming year. The work of the future will be along the lines of straight selection for increased production of short-staple types of cotton, adapting them to the conditions in South Carolina.

Cotton breeding and related work in Tennessee.—Satisfactory progress is being made in fixing an early strain of cotton much better than the King for cultivation in Tennessee. This variety was found in southern Missouri. A number of hybrids are in their first generation, and an extensive series of observations for determining which plants in a progeny row are earliest are being made in order to assist in the breeding for earliness.

An investigation of the oil content of cotton will be completed during the present year. It has been found that the variation in oil in different varieties is not so great as the variation in yield, so that the best way to breed for oil is to breed for productiveness first and then to select for oil content.

Tests of the effect of altitude on cotton are in progress, as are some tests of the treatment of cotton ovules with chemical solutions in the effort to induce variation. Seed from these ovules will be secured for planting next year. The work of the coming year in Tennessee will be largely the multiplication of the improved strains of cotton, which should be available for distribution next season, and further work in breeding the hybrids already obtained.

Breeding early cottons for weevil conditions.—In the work of developing early, prolific Upland varieties of cotton, the two varieties distributed last year, the Tring and the Crenshaw, have taken first place so far in the tests of this year, both in yield and in earliness of opening. Another hybrid is giving very promising results in the same way, and sufficient seed of this will be available for growing for distribution in 1909. In the development of early prolific premium cottons, types with lint from an inch to an inch and a quarter in length have demanded a premium of from 1 to 4 cents a pound. Three promising types of these have been developed, including a hybrid between the Triumph and the Sunflower varieties, which is to be distributed this year.

Breeding work in the production of early long-staple cottons is also under way, and one hybrid has been secured which will be available for preliminary distribution the coming spring. Work has also just been begun in the production of an early-opening cotton, with the object of extending the better varieties into the Panhandle of Texas and Oklahoma, where the early frosts do not allow ordinary cottons to open satisfactorily.

Tests of hybrids in Texas.—In Texas, a test of the selections made by Dr. H. J. Webber, including the Columbia cotton, has been made at two points in the State. Further selection of the two most promising strains of the Triumph and Bohemian varieties for greater earliness and better length of lint has been made, as have some crosses with the intention of throwing light on the general question of breeding. Two strains last year showed decided promise of being especially valuable for distribution, and it is thought that enough seed will be available for this purpose next season. The cotton-seed distribution of last year was carried on in very much the same manner as in previous years. It is planned to keep in closer touch with the cooperators who have received the Columbia cotton this year, in order to find how it is regarded in different sections of the country and to make the next season's distribution with this idea in view.

CORN INVESTIGATIONS.

The corn investigations of the Bureau are under the immediate charge of Mr. C. P. Hartley, Physiologist, assisted by Messrs. Ernest B. Brown, Curtis H. Kyle, and Leslie L. Zook, and in certain phases of the work by Dr. M. Norris Straughn, of the Bureau of Chemistry. The work is so planned that each investigator has charge in a section of the United States extending from the southern to the northern portion. This arrangement permits careful personal supervision at many different points as the seasons advance.

These investigations have as their ultimate object the production of more corn and better corn per acre with less expense and labor. Millions of dollars in labor and millions of acres of land are yearly wasted because the efficiency of the corn plant, when given good care, is not properly appreciated. With reference to this one crop the wealth of the United States could be yearly increased $100,000,000 by the selection of seed from superior individual cornstalks only, another $100,000,000 by the better drying and storing of the seed selected, another $100,000,000 by better care of the growing plants, and yet another $100,000,000 by better care of the soil. This total is but one-third of the farm value of our corn crop, and the work of the Bureau of Plant Industry conducted in 17 States for several years has proved the possibility of doubling the present average yield.

Assistance to corn growers.—All the lines of corn work under way have as their ultimate object the benefiting of farmers engaged in growing corn. The way in which the good results of this work show most directly and effectually is by the practical demonstrations conducted in cooperation with the farmer and on his own farm. At the 27 localities in 17 States at which corn improvement work has been established, the farmers acquainted with the results freely state that the work is of immense value to their locality. Some of the improved strains with which the Department has been experimenting longest have demonstrated their superiority and are now being quite generally grown in the localities to which they are adapted. Much of the time of the investigators is devoted to answering requests regarding many problems connected with successful corn growing, and many acknowledgments have been received from farmers of the profits accruing to them from following the advice given.

CARE OF SEED CORN.—In connection with the corn breeding and demonstration work in various sections dry houses and storage bins have been constructed and are being tested. The construction of these is governed by the particular difficulties of the locality to be overcome. In the South, protection from insects is a leading factor, while in the North thorough drying and the protection of the seed from damp air and subsequent freezes is a most important factor. The success of the corn-growing demonstrations is largely attributable to careful methods of seed production and seed preservation.

POWER OF THE CORN PLANT TO TRANSMIT VALUABLE CHARACTERS.—Last year's studies of individual plants and their power to transmit their characters have proved of much value and are exceedingly encouraging. As a practical illustration of their importance it can be said that 100 bushels of sound mature corn per acre were produced throughout a 20-acre field in south-central Wisconsin, where the cold, backward season caused most other varieties to fail to mature. It was demonstrated that some seed ears produced a progeny that is nearly storm resistant, withstanding a wind that blew down a large percentage of the progeny of other ears planted on either side. Increased ability to withstand frosts and other unfavorable conditions has been observed in the progeny of some seed ears. The variation in power to produce, which is the most important variation from an economic point of view, has been demonstrated, and a test made last year showed plainly the transmission of this very valuable character.

EAR-TO-ROW METHOD OF PLANTING CORN.—The ear-to-row method of planting corn-breeding plats, as devised in 1905, is being adopted quite universally by the best seed-corn producers. Observations made during the past year proved the method to possess many advantages not previously considered. Seed ears selected from the most productive rows of the previous year's breeding plat were planted by the ear-to-row method side by side and alternating with equally fine-appearing ears selected from a general field of the same corn. With scarcely an exception the ears from productive rows of the breeding plat produced more than the ears from the general field. The demonstration shows an increase of 18 bushels per acre in favor of one year's selection for increased yield.

STUDIES OF DROUGHT RESISTANCE IN CORN.—The studies of drought resistance and the degree to which it is transmitted yielded satisfactory results last year. It has been shown that for best results the work must be conducted in a locality that is each year subject to drought. A strain that had for several years been grown in the dry portions of Texas was last year tested in the very dry region of Yuma, Ariz., in comparison with many other introduced strains and proved the most productive of the varieties tested.

Work having as its object the production of drought-resistant strains has been taken up both at Yuma, Ariz., and Chico, Cal., not only for the purpose of producing strains adapted to those sections, but to fix in strains of high-yielding corn the ability to withstand dry conditions, dry soils, and dry, warm winds. Such strains can be planted to advantage in many parts of the semiarid sections where they can not grow well because of the variable seasons.

Studies of environment in corn.—The investigations of environment are being conducted with two strains of sweet corn at a series of stations along the Atlantic coast, and with a strain of field corn at a series of substations from the Gulf to South Dakota. One of the most valuable features of the corn plant is its ability to adapt itself to the environment under which it is grown. The object of the environmental studies is to determine the factors involved, so that more intelligent work can be conducted in selecting varieties for a new environment or locality where corn is not now successfully grown.

Self-fertilization and inbreeding in corn.—As pointed out in a previous report, self-fertilization of a corn plant with its own pollen results in the formation of seed unfit for planting. Judging from this demonstration that the interbreeding of related corn plants is injurious, many complicated systems of corn breeding have been devised for preventing the cross-pollination of related plants. Work has this year been inaugurated having for its object the determination of whether any injurious results follow the interbreeding of related corn plants.

Utilization of the corn crop.—The yearly production of 2½ billion bushels of corn is sufficient for our present needs. The harvest is so bountiful that its full value is not appreciated or utilized. Investigations of the most practical and most successful methods of utilizing the corn crop have been made in every section of the United States, and a Farmers' Bulletin on "Harvesting and Storing Corn" has been published. Further investigations are under way looking to a fuller utilization of grain and fodder. At present large percentages of the grain produced spoil or are destroyed by the grain weevil and grain moth, and large acreages of stalks suitable for the making of paper serve no other purpose than the return of fertility to the land on which they grew.

In connection with desired conditions of soil and climate and methods of planting and cultivating, it is necessary to consider implements that will produce the best results. Implements of new design as well as those of standard types for preparing the seed bed, planting, cultivating, and harvesting are being tested and in some instances the good yields have been to a certain degree traceable to the efficiency of these implements.

Plans for future work.—The facts learned by experiments and observations will be applied in connection with corn improvement and demonstration work. There are many localities for which high-yielding strains have not been produced or bred, and the determination of the best existing variety, its improvement, and a demonstration of its superior producing power should be accomplished in all such localities. This work will be continued at the points at which it has been begun until the perpetuation of the improved strains and their further development is insured by the labor of corn breeders, and similar work will be carried into other localities as fast as funds permit, giving preference to sections most in need of such corn improvement.

TOBACCO INVESTIGATIONS.

The tobacco investigations of the Bureau have been placed for administrative purposes under the joint supervision of Messrs. A. D. Shamel, E. H. Mathewson, and W. W. Garner. Mr. Shamel is engaged personally in the breeding of new types of tobacco and in other related investigations in the Connecticut Valley and other localities; Mr. Mathewson is in immediate charge of the tobacco investigations in Virginia, Maryland, and North Carolina, and also of certain administrative features of the work at Washington; and Doctor Garner is engaged in laboratory investigations of the qualities of the new tobaccos developed in the field experiments.

The most important results of the work of the past year have been secured in the origination, development, and introduction of new and improved varieties of tobacco; the discovery and demonstration of improved methods of curing, fermentation, and handling of cigar tobaccos, of the effects of the use of different kinds of fertilizers on the quality, yield, and character of the tobacco plants, and improved methods for the production of seedlings; the introduction and demonstration of improved methods of bagging seed and of seed separation; and the improvement of established varieties by growers by the use of the methods of breeding and seed selection originated and developed by the Bureau of Plant Industry. The following outline gives a brief statement of some of the important results of these investigations in the various tobacco districts during the past fiscal year:

TOBACCO INVESTIGATIONS IN THE CONNECTICUT VALLEY.

New varieties of tobacco.—In the Connecticut Valley seven new varieties of tobacco have been originated, tested experimentally and commercially, and adopted by growers of cigar tobacco. Of these seven now established varieties, three are adapted for growing under shade and four in the open. The Uncle Sam Sumatra variety originated in the Connecticut Valley in 1903 has come into extensive use for growing under shade in Florida, Georgia, Alabama, Texas, Porto Rico, and to a limited extent in the Connecticut Valley. It is adapted for cigar-wrapper production, having ideal size and shape of leaves, the plants of the best strains producing an average of 26 good leaves; is comparatively suckerless and develops during curing and fermentation light, desirable colors and other qualities.

The Hazlewood Cuban, a variety originated in the Connecticut Valley in 1903, has been found to be especially adapted to production under shade in that valley. The origination, development, and introduction of this variety have been the principal factors in putting the production of tobacco under shade in the Connecticut Valley on a profitable commercial basis. Demonstrations by this Bureau have shown that under ordinary conditions this variety can be produced by growers in Connecticut with a reasonable profit and that the success of the industry is assured.

An as yet unnamed variety, originated from Florida Sumatra seed grown in the Connecticut Valley, called in the experimental tests the Greenleaf type, gave last year the best results of any of the varieties tested under shade. It produces an average of 30 good leaves to the plant, of ideal size and desirable shape for cigar-wrapper manufacture, and develops a highly desirable color and quality during curing and fermentation. Arrangements have been made with growers to test this variety extensively on a commercial scale in Connecticut, Florida, and other shade districts next season.

Of the four new varieties adapted for growing in the open originated by the Bureau of Plant Industry in the Connecticut Valley, the Cooley Hybrid has come into the greatest use by growers so far. This variety was developed from a sport resulting from a cross of Connecticut Havana seed and Uncle Sam Sumatra. Another variety developed from a sport resulting from a cross of Connecticut Havana seed and the Greenleaf type of Sumatra, named this season the Halladay tobacco, has proved to be one of the most important new varieties of tobacco ever produced. It produces an average of about 31 leaves to the plant in comparison with from 16 to 18 leaves in the case of the older variety of Havana seed heretofore grown, and the leaves are of better size, shape, and quality than the parent Connecticut Havana seed. Arrangements have been made by tobacco growers in the valley with the growers of the Halladay tobacco for seed enough to grow several thousand acres of this improved variety next season. The Brewer Hybrid, developed from a sport resulting from a cross of the Connecticut Broadleaf and Cuban varieties, has been tested extensively in the Broadleaf belt of the valley. As a rule the results have been generally satisfactory and the variety has been shown to be a valuable one for these conditions. It is especially adapted for priming rather than cutting the entire plant. Another variety, as yet unnamed, developed from a sport resulting from a similar cross to that of the Brewer Hybrid promises to be valuable for certain districts and will be tried extensively by growers next season. The Brewer and Cooley hybrids have been grown in the tobacco districts of New York, Pennsylvania, and Ohio with promising results. Many growers in these districts have made arrangements to plant their entire crops of these improved varieties next season as a result of the past season's demonstrations.

STEAM STERILIZATION OF TOBACCO SEED BEDS.—The discovery by this Bureau of the existence of the tobacco root-rot disease, *Thielavia basicola*, in the tobacco seed beds of the Connecticut Valley led to the experimentation with methods for controlling the disease in the beds. As a result of these experiments a method of sterilizing the seed-bed soil with steam before sowing was devised and introduced. The demonstration tests of this method the past season by growers in the valley have proved that not only is this disease destroyed by the use of steam, but that weed seeds and other fungous diseases are killed, thus reducing markedly the cost of the production of tobacco seedlings. In addition to these important facts, seedlings are grown from seven to ten days earlier in steam-sterilized soil than otherwise, an important factor in all northern tobacco districts having short seasons. This method has been proved to be economical and practical and has been adopted by many growers.

HAIRY VETCH AS A COVER CROP FOR TOBACCO LANDS.—It has been demonstrated by this Bureau by extensive practical field tests in the Connecticut Valley that the sowing of hairy vetch immediately after harvesting the tobacco crop conserves fertility, adds to the nitrogen content of the soil, improves its mechanical tilth, and prevents the loss of soil by blowing, drifting, or washing. Crops of tobacco grown after hairy vetch cover crops produce larger yields of a higher and better quality and the plants are more free from calico or mosaic disease than where no cover crops have been grown or where rye or oats have been used for this purpose. A considerable saving in nitrogenous fertilizers is effected by the use of hairy vetch, which in the aggregate amounts to an important saving to the growers. Some failures in the use of hairy vetch have occurred, but these when traced to their source have been due, so far as has been determined, either to the use of imported vetch seed (in some cases not hairy vetch at all) or to the use of improper methods of sowing the seed. An acclimated strain of Russian hairy vetch has been developed by this Bureau by seed selection, and improved methods of culture have been discovered, so that the sowing of this seed is extending rapidly all over the valley. This acclimated variety of this legume is also being tested in New York, Texas, Pennsylvania, Ohio, and Wisconsin.

FERTILIZER EXPERIMENTS.—Cooperative experiments in testing the value of finely ground feldspar as a source of potash for tobacco fertilizers, the effect of different sources of potash on the quality of the "burn" of tobacco, the treatment of diseased and so-called worn-out soils by special fertilizers, the use of acid phosphate for the treatment of alkaline soils, both of the latter experiments being conducted in cooperation with Dr. L. J. Briggs, of this Bureau, and minor tests are being carried on under favorable conditions for obtaining conclusive and valuable results. The experiments have been conducted cooperatively for the past two years and will require data for another season or for several seasons for final results from which safe conclusions can be drawn. Already sufficient data have been obtained to show that most important knowledge has been secured as to the relation of the use of certain potash fertilizers and soil-fungus diseases, the residual effect of certain commercial fertilizers on the character and quality of the tobacco crop, and the condition of the soil as affected by varying amounts and kinds of commercial fertilizers and sources of plant food.

COOPERATIVE BREEDING WORK.—Owing to the demands by growers for help in starting the systematic improvement of tobacco by breeding and seed selection, this Bureau has made arrangements to lay out the plan of a breeding field, supply small quantities of seed of the improved varieties, and demonstrate the method of bagging seed and seed separation with a limited number of growers in the different districts in the Connecticut Valley. The result has been that many growers who are so situated as to make such work possible have taken up systematic breeding with one or more varieties. Their fields become centers of interest in the different neighborhoods, from which all other growers may receive, if they desire, the benefit of this work. The seed and seedlings furnished to growers by these cooperators, the quantity of seed separated, and the number of visitors to these breeding fields constitute a complete vindication of this method of introducing improved varieties and methods of culture.

Cooperative work with the Connecticut Agricultural Experiment Station at New Haven has been undertaken looking to a classification of all existing varieties of tobacco in order to assist breeders and growers. Such information is greatly needed and is entirely lacking in English literature. A large collection of samples of tobacco seed of different varieties secured by the Office of Foreign Seed and Plant Introduction and much other seed has been brought together. One crop from this seed was grown and observed the past season. A systematic study of some of the fundamental problems of heredity have been undertaken in this connection. A large number of new hybrids for production both under shade and in the open are being tested. New machinery for transplanting seedlings, for stringing leaves, and for other features of culture is in process of making and testing.

The Connecticut Valley is undoubtedly favorable for the breeding of new varieties of tobacco adapted not only to that valley but to many other important tobacco districts of the United States and its possessions. This fact has been clearly demonstrated by the origination in this valley by this Bureau of the most valuable new varieties of tobacco produced anywhere in the world for cigar-tobacco production in the past quarter of a century.

CHEMICO-PHYSIOLOGICAL TOBACCO INVESTIGATIONS.

Breeding experiments for nicotine content.—The breeding of strains of cigar tobacco for high and for low nicotine content was continued the past year. A selection of Connecticut Cuban tobacco was found to contain only eighty-five one-hundredths of 1 per cent of nicotine. Another selection of this same variety was found containing over 3 per cent of nicotine. Both of these strains, together with a large number of others, are being grown this year to determine the practicability and desirability of fixing this character of high or low nicotine content. In addition to these breeding plats in Connecticut, Florida, Texas, and Ohio, special field experiments are being carried out to determine the influence of soil and climatic conditions, fertilizing, topping, and suckering on the production of nicotine.

Flavor and aroma of tobacco.—The relation of the composition to the flavor and aroma of tobacco has been studied during the past year. In general the results to date serve to strengthen the belief that these qualities are essentially type characters and therefore furnish a particularly fruitful field for systematic breeding. The most direct result of this work, however, up to the present time has been the recognition of the presence of nicotine in tobacco in two essentially different forms of combination. It has been found that the biting, irritating property of smoke from domestic cigar fillers is due to nicotine in an easily volatile form and may be overcome either by extraction with petroleum ether or by the addition of citric acid and other similar organic acids.

Improved methods of curing tobacco.—No phase of cigar-tobacco production is more in need of substantial improvement than the curing process. Investigations of the essential changes in composition of the leaf effected by the curing process are under way, as well as the determination by extensive and accurate tests of the most favorable conditions of temperature, humidity, ventilation, etc., for accomplishing these changes. This work has included a study of conditions which lead to the dreaded pole-sweat and of methods of preventing its development. As a result of these investigations one section of a curing barn at Suffield, Conn., has been fitted up with a steam-heating system and another portion with a system of flues for hot-air heating. These systems are both being tested in a practical way, and will afford an effective demonstration of the best methods of placing the conditions in the curing shed under control, thereby assuring satisfactory curing without reference to outside weather conditions.

An investigation begun last year on the important changes in the composition of the tobacco leaf occurring during the fermentation process was continued and is now nearly complete. As a result of this study a formula for a petune designed to improve both the burn and aroma of cigar tobaccos has been devised and will be tested on a practical scale this season.

TOBACCO INVESTIGATIONS IN FLORIDA AND GEORGIA.

Cooperative breeding experiments.—In Florida during the past season the Bureau of Plant Industry cooperated with eight tobacco growers in the different sections of the shade-tobacco district in the carrying on of individual breeding fields. The Bureau furnished the plan of arrangement for these fields, varying from 1 to 4 acres in size, furnished small quantities of seed of the improved types and varieties originated and developed by the Bureau, and assisted in making seed selections, saving seed under bag, and in seed separation. Samples of leaves from the different varieties and plats and the leaves of special individual seed plants with their seed have been saved and cured, and during the coming winter will be fermented and tested for burn, taste, flavor, aroma, nicotine content, etc., in the tobacco laboratory of this Bureau. In addition to these large breeding fields, the Bureau cooperated with a number of growers in the conduct of smaller breeding patches located in Florida and Georgia.

Fertilizer tests of the effect of different sources of potash on the yield and quality of the leaf were begun under favorable conditions. The production in the open of improved Cuban varieties for cigar fillers was continued and important results were secured. Strains of tobacco of high and low nicotine content were grown with a view of securing a practical cigar filler of mild quality but fine flavor and aroma—a matter of the highest importance to a large class of cigar smokers. The introduction of the Iron cowpea as a cover crop and the demonstration of its value for tobacco lands has been followed by the general adoption of the practice of using this nitrogenous fertilizer as a source of humus. The Iron cowpea is resistant to nematodes and is especially suitable for use as a cover crop in this tobacco district.

Tobacco diseases.—A serious wilt of tobacco has been discovered during the past season in two continuously cultivated shaded tobacco fields in Florida. This wilt, the soil producing the diseased plants, and other factors are being studied in order to develop practical means of preventing the spread and recurrence of this disease. The nematode-resistant variety of tobacco originated by this Bureau in Florida, a strain of the Uncle Sam Sumatra variety, was so far as observed immune to nematodes the past season, while other fields of different varieties were affected.

PROGRESS WITH NEW HYBRIDS IN FLORIDA.—The Uncle Sam Sumatra variety has been generally adopted, under the name of "Type 3," its experimental number, by shade-tobacco growers. The best strains of this variety the past two years have given an increased yield of improved quality of cigar-wrapper leaf. Some of the strains are superior to others, a matter which can be determined only by experience. A large number of seed selections of Uncle Sam Sumatra and other varieties, new hybrids, and types were tested the past year. The complete results of these tests can not be determined until next spring, after fermentation, sorting, sizing, and testing.

TOBACCO INVESTIGATIONS IN ALABAMA AND TEXAS.

AIDING THE ALABAMA TOBACCO INDUSTRY.—In Alabama the yield and quality of the tobacco crops previous to last season were such as to discourage both growers and buyers. In fact, without hope that higher yielding strains of improved quality could be secured by breeding new and acclimated varieties the industry would have been abandoned in northern Alabama. During the past season about 7 acres of Sumatra varieties and types were grown under shade for cigar wrappers and about 30 acres of Cuban types in the open for cigar fillers. The Uncle Sam Sumatra is the most promising shade variety, while a new type of Cuban tobacco originated in Texas is the most promising variety for outdoor culture. The quality of the first season's crop from the improved varieties was much better than any heretofore grown, and the yield was much higher than in the past. If the market will take hold of these tobaccos it is probable that this industry will have a fair prospect of success.

WORK IN TEXAS.—The past season in Texas about 70 acres of Sumatra types were grown under shade for cigar wrappers, and about 250 acres of Cuban types were produced in the open for cigar fillers. The strains of seed used for the most part were distinct improvements on the imported and unacclimated strains of necessity used in previous years. By careful seed selection the seed saved under bag, particularly in 1907, developed uniform types that gave under the fairly favorable crop conditions of 1908 satisfactory yields of tobacco possessing high quality.

POLICY FOLLOWED IN ALABAMA AND TEXAS.—The work of the Bureau of Plant Industry in both Alabama and Texas has been confined to growing the best types of seed available, testing methods of fertilizing and cultivating the field, and giving to such growers as desired it expert information as to methods of culture, curing, and fermentation. The results of the tests of the past season will give the Alabama and Texas growers, as well as the trade, reliable data as to the character, yield, and quality, as well as to the cost, of the tobacco produced. In no case has there been any effort to boom the industry or to push it in any way, but instead all efforts have been concentrated in securing valuable data by careful experimental methods as to the profitableness of the crop for the farmers of these districts, and in assisting by expert advice the farmers who wish to grow tobacco where the conditions were favorable to the development of a valuable tobacco, particularly a cigar-filler tobacco.

TOBACCO INVESTIGATIONS IN VIRGINIA AND MARYLAND.

Experiments in Virginia.—In 1907 experimental work was conducted at two points in Virginia, namely, at Appomattox, in the "dark" district, and at Chatham, in the "flue-cured" district. At the Appomattox station the work comprised two series of fertilizer experiments with tobacco, of 14 and 16 plats, respectively, one-half of each plat being limed at the rate of 1 ton per acre. Very important suggestive results were realized on these plats, the yield varying from 810 pounds per acre on the unfertilized plats to 1,650 pounds per acre on the highly fertilized plats, with an increase in value from $56.19 to $154.37. By the use of lime there was an average increase in yield on all the plats of one series of 133 pounds per acre and on the other series an increase of 174 pounds per acre, with a corresponding increase in the value of the tobacco. These plats were planted in wheat without further manure or fertilizer, and the yield varied this year from 10 bushels to 28 bushels per acre, solely as the difference in the after-effect of the fertilizer used on the tobacco. These plats will now be sown in grass and followed through the entire rotation, thus giving valuable and suggestive data as to the combined effect of the rotation and the different fertilizer treatments on the building up of the land.

Expansion of the work in Virginia.—Based on the success of the experiments in 1907, the Virginia State legislature, through the Virginia Agricultural Experiment Station, increased the appropriation available for their share of this work from $1,500 to $5,000 annually. This action made possible a considerable expansion of the work in 1908, and experiments and demonstrations were initiated at three new points, viz, Rustburg, Bowling Green, and Louisa, in addition to a considerable extension of the work at the old headquarters at Appomattox and Chatham. At each of these points fertilizer plat experiments have been carried through the entire crop rotation, and crop-rotation demonstration plats have also been conducted on a field scale. Efforts are also being made by seed selection and breeding to improve the yield and quality of the plant itself. Experiments for combating insect pests, especially the cutworm, wireworm, and hornworm, are also in progress by the use of insecticides and by crop-rotation methods.

Tobacco work in Maryland.—The tobacco work in Maryland in 1907 consisted entirely of breeding experiments as planned and initiated in previous years. In 1908, however, this work was continued on a somewhat different basis, and fertilizer and crop-rotation experiments and demonstrations similar to those under way in Virginia were added, with headquarters at Upper Marlboro, in Prince George County. No results are yet available, but the experiments give promise of results of great value. In the breeding work, two new varieties, as yet unnamed, developed from sports resulting from crosses of the Maryland Smoking tobacco with Connecticut Broadleaf and White Burley, have been found to give a higher yield of better tobacco than the established Maryland Smoking type. These varieties are being extensively tested by tobacco growers in Maryland. The improved methods of saving seed under bag and of seed separation have been introduced into Maryland with marked success. All of the Maryland work has been conducted in cooperation with the State experiment station, which has offered every facility and assistance needed for carrying on the work by this Bureau.

TOBACCO INVESTIGATIONS IN OTHER STATES.

KENTUCKY AND TENNESSEE.—The tobacco investigations in this district have naturally been divided into two fields of effort, viz, the improvement of the White Burley tobacco of central and northern Kentucky and the improvement of the dark tobaccos of western Kentucky and northern Tennessee. The principal work done in these two great districts has been the introduction of methods of saving seed under bag from carefully selected seed plants, the use of seed separators, and the testing of the established varieties in various localities of these districts as a basis and guide in the work of creating new varieties by means of hybridization and seed selection. Fertilizer tests have also been carried on in typical areas of both the dark and White Burley districts. These tests must be continued at least another season before any decisive results can be given or safe conclusions drawn. This work is carried on in cooperation with the Kentucky Agricultural Experiment Station, the headquarters being in the station building at Lexington. Many of the most important breeding and other experiments with the White Burley tobacco are carried on at the station, where exceptional facilities are offered for this work.

OHIO.—The Ohio tobacco investigations are conducted in cooperation with the Ohio Agricultural Experiment Station. The station carries on all of this work on its experimental plats, this Bureau assisting mainly in testing and judging the cured and fermented tobacco. The principal work under way is the breeding of improved varieties of cigar-filler tobaccos, the study of the nicotine content of the Ohio tobaccos, and the introduction among tobacco growers and breeders of better methods of saving seeds, seed separation, and fermentation.

NEW YORK.—In the New York tobacco district the main work of the past year has been the continuation of the fertilizer tests and demonstrations, the introduction of the bulk method of fermentation and of better methods of seed saving and separation, the testing of new varieties which are thought to be adapted to this section, and the introduction of vetch as a cover crop for tobacco lands.

TOBACCO SEED DISTRIBUTION.

In addition to the seed of new and improved varieties distributed directly from the breeding fields to cooperators, there has been carried on the past year, as in the two previous years, in cooperation with the Office of Seed Distribution of this Bureau, a distribution of small samples of seed in all of the tobacco districts in which experimental work has been conducted. During the past year about

10,000 such samples were sent out to growers on request, and reports requested on the results of the tests. In addition to these small samples, about 300 samples of seed in larger quantities were sent to growers in response to special requests.

MISCELLANEOUS PLANT BREEDING INVESTIGATIONS.

For administrative purposes several isolated projects of a plant breeding nature have been placed under the general supervision of Mr. A. D. Shamel, Physiologist, in addition to his other work on cotton and tobacco. These projects cover the breeding of potatoes, asparagus, cover crops, etc. Following is a summarized statement of progress made in these lines during the past fiscal year:

IMPROVEMENT OF POTATOES.

In the season of 1907, tests of 233 new types of Irish potatoes were made at Hockanum, Conn. These types were selections developed from seedlings grown in 1902. Of the 233 types tested it was found that 42 possessed special features of yield, quality, and appearance that warranted their further propagation. The past season these 42 types have been planted and grown under favorable circumstances at Hockanum, and of these, 4 distinct new types of tubers have proved worthy of commercial production. Enough tubers of these new and improved varieties were produced in 1908 to make a limited distribution the coming season. Of the remaining 38 types a number of the most promising sorts will be tested in different districts which seem most suitable for their propagation.

It is planned to make a large number of crosses in 1909 between the new types, with a view of securing variability as a basis for further selections of still more improved types. Several of the types tested the past season were apparently blight resistant. It is planned in 1909 to test these types in sections of the potato districts where the blight has been particularly destructive.

BREEDING RUST-RESISTANT ASPARAGUS.

The asparagus breeding work conducted at Concord, Mass., in cooperation with the Massachusetts Agricultural Experiment Station, has been enlarged the past season by the addition of a number of new varieties and types of asparagus to those previously tested. The total number of types and varieties now growing in this field is 76, which does not take into account a hybrid between a South African rust-resistant species and the standard American-grown Conovers Colossal. This hybrid, made by Mr. George W. Oliver, of this Bureau, was transplanted from the greenhouses of the Department of Agriculture in Washington to the breeding field at Concord the past spring. The hybrid plants have made a vigorous growth during the summer and so far are immune to the attacks of rust. Of the 76 types and varieties under observation, several appear to be resistant to the rust and in addition possess a habit of growth that makes them particularly desirable for commercial propagation. Two of these apparently resistant and valuable foreign-grown varieties have been propagated on a large scale, so that a comprehensive test may be made of their qualities in all of the rust-affected areas in the United States.

An entirely new experiment was begun in this connection at Concord the past spring. A portion of an established asparagus bed was covered with the coarse cheese cloth used on shaded tobacco fields and arranged in the same way. The asparagus under cloth produced an earlier, more tender, and more highly flavored crop than the outside-grown asparagus, was protected from a destructive frost in the latter part of May, and the plants during the summer have attained a height of from 2 to 3 feet greater than outdoor plants. This experiment will be continued several seasons in order to secure accurate data as to the profitableness of this new method.

COVER-CROP BREEDING WORK.

HAIRY VETCH.—In 1904 Russian-grown hairy vetch (*Vicia villosa*) seed was planted in Connecticut. Hardy seed has been sown from year to year until the past season, when practically all of the plants were hardy and a yield of about 15 bushels per acre of vetch seed was secured. This acclimated seed has been distributed to growers on request and will be sown for seed production. It has been found by this Bureau by demonstration tests in Connecticut and other northern tobacco districts that the yield of tobacco on land previously covered by hairy vetch is larger, the quality better, and the tobacco plants more free from disease than on land not so treated. Not only are the yield and quality of tobacco improved, but the cost of commercial fertilizer heretofore necessary to grow the tobacco crop is materially reduced.

In 1909 special attention will be given to the economic propagation of seed of the acclimated strain in the Connecticut Valley.

WINTER OATS.—In 1905 winter oats from Kentucky were planted in Connecticut in the fall on tobacco land, after the tobacco crop had been removed, for cover-crop purposes. Only a few of the plants proved hardy. The seeds from these hardy plants were saved and sown in the fall of 1906, and again the hardy plants of 1906 were sown in the fall of 1907. The past season the strain of winter oats at Hockanum proved to be hardy, most of the plants surviving the severe winter season. The seed of this hardy strain has been distributed in several districts where tobacco growers desire to test a cover crop of this character.

MISCELLANEOUS COVER-CROP TESTS.—In cooperation with Prof. C. V. Piper, of this Bureau, a large number of tests of legumes are being made at various points in the tobacco districts. Strains of barley, wheat, and several other crops are being tested on a small scale in different sections for their effectiveness as cover crops for tobacco lands.

Arrangements have been made and seed collected to begin a series of experiments in order to determine some of the principles of the science of breeding. Mr. J. B. Norton will carry on this work. The field experiments of this Bureau in breeding tobacco, cotton, and other crops furnish a wide field for observation, from which it is hoped that data may be collected and correlated which will advance the knowledge of the fundamental principles of plant breeding.

SUGAR-BEET INVESTIGATIONS.

Investigations relating to sugar beets, including laboratory, greenhouse, and field studies, have been in charge of Dr. C. O. Townsend, as heretofore. Mr. J. E. W. Tracy is associated with Doctor Townsend in the sugar-beet work and has direct charge of developing high-grade strains and the production and testing of commercial sugar-beet seed.

Certain lines of work pertaining to the sugar beet, notably those relating to alkali and drought resistance, have been conducted in cooperation with Mr. T. H. Kearney, Physiologist in Charge of Alkali and Drought Resistant Plant Breeding Investigations in this Bureau. Cooperative work with sugar beets is also in progress with the State agricultural experiment stations of Utah, South Dakota, Minnesota, Michigan, and New York (Geneva).

The following lines of work have received special attention during the past year:

Developing and establishing high-grade pedigree strains of sugar-beet seed.—This work embraces the selection of high-grade beets which are individually analyzed and recorded from generation to generation, thus establishing the distinct line of development. In making these selections, not only is attention given to the quality of the beet, which is considered of prime importance, but care is taken to select beets of most desirable shape and of satisfactory weight. Attention is also given to leaf form, size, and habit. This work has been carried on in five different localities, embracing distinct soil and climatic conditions. Efforts are being made to extend the work into other sections of the country and to carry it forward on a still larger scale for the purpose of determining where sugar-beet seed may be grown to best advantage in the United States. Enough has already been done to show that a high grade of pedigreed sugar-beet seed can be grown in this country. During the several years that this work has been under way there has been a steady increase not only in the quality of the beets selected but also in their size and shape. Some of the seed beets have yielded 24 per cent of sugar with a weight of one-half pound to 2 pounds, and, in some exceptional cases, still heavier. The seed from these selected beets is carefully gathered and kept separate. Plants showing any inclination toward weakness or retrogression in point of sugar content or other desirable quality are discarded. Only the best and most promising are kept for future development of the work.

Commercial production and testing of American-grown seed.—During the past several years a large number of experimenters throughout the sugar-beet area have tested American beet seed which was grown on a commercial scale.

These experiments are conducted under the direction of this Bureau, and the results indicate that sugar-beet seed of a grade equal to any imported seed can be grown commercially in this country. The tests made show that the seed is of remarkable vigor and strength, as indicated by its quick germination and by the vigorous seedlings produced. Several hundred thousand pounds of sugar-beet seed are now grown annually in this country, and the acreage in certain localities, notably in Washington State, is steadily increasing.

In the comparative test experiments American-grown seed has been compared with most of the leading varieties of foreign beet seed. This is the seventh year that these tests have been carried on, and a report showing the result of this work is now in preparation.

It has been deemed advisable to conduct these comparative experiments for a series of years in order to establish a reasonable basis for comparison. The results thus far obtained show that the American-grown seed compares very favorably with the imported varieties, the yield of sugar per acre being about 600 pounds greater with American seed than when any of the foreign varieties used in comparison were sown. After having fully demonstrated the ability of American soil and climate to produce high-grade sugar-beet seed, it will be the aim to aid, so far as is consistent and proper, in the establishment of sugar-beet seed farms, giving to those who wish to engage in such an enterprise assistance which will enable them to work along right lines.

DISEASES OF THE SUGAR BEET.—Investigations into the causes of the various sugar-beet diseases have been continued during the past year and likewise remedies have been sought whereby these diseases may be controlled.

In addition to curly-top and leaf-spot, several other diseases have been more or less destructive during the past year. This is true especially of crown-rot and root-rot. One or two apparently new diseases have made their appearance and are now under investigation. During the past year a bulletin was published on curly-top, bringing this phase of our investigations up to date and pointing out the important fact that this disease has not occurred two years in succession in the same locality to any serious extent. There has been no serious outbreak of this disease during the past year, but numerous cases have occurred throughout the sugar-beet sections of the West. The past season's experiments at Garland, Utah, as well as our greenhouse experiments in Washington, point conclusively to the fact that this disease is caused by the leaf hopper, *Eutettix tenella*. This confirms the conclusion reached by Doctor Ball, of the Utah Agricultural Experiment Station, as a result of his field observations in this connection.

Leaf-spot, due mainly to a fungus known as *Cercospora beticola*, was more or less serious through the eastern and middle portions of the sugar-beet belt. This disease seems to be extending farther and farther west with each succeeding crop of beets. Although it is not expected that it will become especially serious in the irrigated sections of the country, since a certain degree of moisture is required for the proper development of the fungus, as stated in previous reports, we have demonstrated beyond question that this disease may be controlled by spraying with Bordeaux mixture. The most important aim of our investigations in this connection at present, therefore, is directed toward determining the practicability of spraying sugar beets on a commercial scale. These experiments have been under way for some time and it is hoped to have definite results in the near future.

Root-rot, due to the fungus known as *Rhizoctonia betae*, may be controlled by the liberal use of air-slaked lime. This fungus lives in the soil and spreads from beet to beet, causing the infested spot to become larger and larger. In applying air-slaked lime, it is recommended that a liberal supply be spread all over the infested spot and for 2 or 3 feet beyond its apparent border and then thoroughly hoed into the soil. This treatment should be given this disease as soon as possible after it makes its appearance.

Crown-rot is usually due to a fungus, *Phoma betae*. This was quite noticeable in several of the sugar-beet sections during the past year, and the indications are that it may be controlled by spraying with Bordeaux mixture. The practicability of spraying on a commercial scale has the same importance here as with leaf-spot. Further investigations will be conducted along this line from time to time whenever outbreaks of the disease occur, with a view to determining the most satisfactory method of preventing this fungus from attacking the beets.

In this connection it should be stated that a number of important diseases of other crops are receiving attention in the sugar-beet laboratory and greenhouse. Worthy of note among these is a gall disease, from a study of which the cause of the crown-gall of the peach has been definitely determined. A gall disease of similar appearance occurs on the sugar beet. Diseases of clover, alfalfa, and other field crops often grown in rotation with sugar beets are receiving attention.

SINGLE-GERM BEET SEED.—Our investigations in connection with the development of single-germ beet seed have been conducted at three stations during the past year. It has been found advisable to divide the work among these stations to prevent any possible loss that might occur if all of the work were in one place.

Inasmuch as two years are required for seed production, the work of the past year was largely a repetition of the preceding year; hence, no marked advance in the percentage of single-germ seeds was expected. The results, however, show a tendency toward single-germ seed production, and we hope that during the present year considerable advance will be shown in the number of single-germ seeds per plant. We expect to continue to work at the three stations the coming year. A large number of roots from single-germ seeds are now being produced, and seeds from last year's plants have been harvested. The work of producing seeds having two or more germs per ball has been continued, and it is hoped to develop simultaneously single, double, triple, and higher germ seed balls for the reasons indicated in the last report.

SELECTION OF BEETS.—In addition to the selection work along the general lines of improving sugar beets, the development of strains of beets resistant to alkali and drought have been undertaken. This work has now been under way for several years in cooperation with Mr. T. H. Kearney, Physiologist in Charge of the Alkali and Drought Resistant Plant Breeding Investigations of this Bureau. During the past winter our beets kept very satisfactorily and were planted in four different places for seed production. The outlook is promising for a satisfactory quantity of seed, and it is to be expected that by continued selection and planting under proper conditions the desired results will eventually be attained. Those plants that show no particular tendency toward resisting alkali or drought conditions are eliminated to a large extent by nature, or are too small to be of practical value and are therefore discarded, so that only the best and most promising of the plants are retained for future work. In these selections more or less attention is given to the size, shape, and quality of the beet, as well as to its power to resist adverse conditions. It is our purpose to continue these cooperative experiments until the desired results are obtained.

Cultural methods for sugar beets.—As stated in the preceding report, various methods of preparing the seed bed, planting the seed, and caring for the crop have been carried on during the past season as nearly as possible in exact duplication of the work of the preceding year. We have not attained as decided results with some of the cultural methods as was anticipated. For example, subsoiling has not given the results expected. For the width of the row, 28 inches was decided to be too wide and that method was discarded. So far as our investigations have been conducted late cultivation is to be recommended. Other problems along the same lines are still under investigation and definite results that will be of considerable value to the grower are hoped for in the near future.

Fertilizers for sugar beets.—Fertilizer investigations have been conducted during the past year along the same lines as formerly, keeping in mind the various points to be solved, namely, the best form of fertilizer to use and when and how it should be applied.

Our results thus far are in favor of green manure in the form of a leguminous crop. For the West, alfalfa is to be recommended, while for the middle and eastern portions of the sugar-beet belt, where alfalfa is not so generally grown, cowpeas or clover are of great value. Stable manures have been found very satisfactory, but the supply is too limited for general use in connection with sugar beets. This form of fertilizer should be in a thoroughly rotted condition when used.

Commercial fertilizers are variable in results produced, much depending apparently upon the physical condition of the soil during the growing season. If the soil is not in good physical condition, commercial fertilizers seem to have little effect upon the crop, while, on the other hand, if the soil is rich and in good condition commercial fertilizers are not needed and often produce no appreciable effect upon the quality or yield of beets. If, however, the soil is in good condition physically, but is deficient in plant food, commercial fertilizers yield a good profit for time and money expended. We expect to continue our fertilizer experiments until other important questions in connection with them are definitely settled.

Siloing seed beets.—One of the greatest difficulties in the way of beet-seed production in certain localities in this country is due to the difficulty of keeping the seed beets through the winter. Realizing the importance of this phase of beet-seed growing, numerous experiments for the purpose of determining the best general method of keeping sugar beets during the winter have been carried on. In our experiments during the past winter various methods of covering the beets were used. Among the materials used were straw covered with soil, burlap covered with soil, soil alone, and sand. Some of the beets were also treated with various kinds of fungicides before siloing. For this purpose copper sulphate, Bordeaux mixture, formalin, and mercuric chlorid were used. Beets were soaked in one of these solutions for a definite time and then siloed.

The most serious difficulty experienced during the past winter was with field mice. Many of the crowns were injured in all silos except those where sand was used for the covering. In these the beets kept almost perfectly. These experiments will be repeated with such additions and changes as the experience of the past winter suggests.

Extension of the sugar-beet area.—During the past year several hundred requests for samples of sugar-beet seed for trial have been received from farmers living in many of the States where sugar beets are not now grown commercially. So far as possible these requests have been complied with, and the indications are that several new sugar-beet areas will develop as a result of these tests. In sending the seed, instructions for planting and caring for the beets are furnished at the same time, and samples of beets from these fields or plots are tested for sugar and purity at the end of the season. These tests are made in the Bureau of Chemistry or at the State agricultural experiment stations. Much interesting and valuable information regarding the possibilities of growing sugar beets in other sections is obtained in this manner, and while the farmers have not as a rule any market for the beets grown they find them very valuable for stock feed, and for this purpose the beets repay them for the labor and expense incurred. Efforts are always made to have several farmers in the same locality grow beets, in order that all of the varieties of soil may be tested and so that in case one or more of the farmers fail to produce beets samples may be obtained for the sugar and purity tests. It is also our expectation that when a community takes up this work it will continue the experiments for several years unless the results of the first year are so far below the standard required that further investigations seem useless.

Sugar-beet by-products.—Information regarding the use of the by-products of the sugar factories is being collected and filed for future use. This relates not only to the tops of the beets which are left in the field, but also to the waste molasses, pulp, and other by-products of the factories. Many of these things undoubtedly have commercial value, and it is the aim of this office to help the grower and manufacturer to find the best possible use for all parts of the beet and for all the by-products developed directly or indirectly in the manufacture of sugar. It is evident that in some localities certain of the by-products can be used to best advantage in one way, while in other portions of the sugar-beet belt they may be of greater value when utilized in an entirely different manner. These matters are receiving careful attention, and as soon as sufficient information of a definite nature is obtained reports will be prepared for publication.

ARLINGTON EXPERIMENTAL FARM AND TRUCK-CROP INVESTIGATIONS.

The maintenance and improvement of the Arlington, Va., Experimental Farm and the allied investigations in horticulture have continued in charge of Prof. L. C. Corbett, Horticulturist. The work of vegetable testing, conducted by Mr. W. W. Tracy, sr., has been affiliated with the other truck-crop investigations, as heretofore stated.

WORK OF THE ARLINGTON EXPERIMENTAL FARM.

The work of the Arlington Experimental Farm has been continued, as in the past, under the immediate direction of Professor Corbett. The popularity and value of the farm as a field laboratory for use by all branches of the service requiring such aid is annually increasing This is due to improved soil conditions, better equipment both in buildings and tools, and a more thorough understanding of the character of work required from them by the laborers. In this respect the farm is serving the purpose for which its promoters have been striving.

INVESTIGATIONS CONDUCTED BY VARIOUS BUREAUS.—All the Bureaus conducting lines of work at the farm enumerated in the last annual report are continuing their investigations, and in several cases have notably increased them. This is true of the work of the Forest Service and of the drug garden. During the year the home field work of cereal investigations has in part been transferred to the farm, and new plantations of fruit trees for the study of crown-gall and hairy-root have been established.

BUILDINGS.—During the year the farm and shop buildings have been painted and partially remodeled, the gasoline engine has been removed from the barn, and the machine and plumbing shop has been transferred from the basement of the barn to the first floor of the shop building. The space thus vacated has been converted into box stalls and harness and carriage rooms. This brings all the stock into one building, and the shops together in another. A 7½-horsepower electric motor which furnishes power for grinding and thrashing has been substituted for the gasoline engine and installed in the mill room. A 5-horsepower electric motor has been installed to furnish power for the drill press, pipe-threading machines, forge, etc., in the machine shop and a saw and jointer in the carpenter shop. The electric line has been extended to the drug laboratory to furnish power for the electro-culture work and the necessary cleaning and grinding machinery used in connection with the drug experiments. A boiler has also been installed in the basement of the drug laboratory for heating and distilling purposes. A third boiler is now being installed in the central heating plant, which has been extended to all the buildings except the drug laboratory.

GREENHOUSES.—One house has been devoted to a study of the merits of blind versus flowering wood cuttings in rose growing; one house and a half to fertilizer studies in carnation growing; one-half house to a variety study of forcing types of radishes, and two houses to the study of greenhouse physics, lettuce being used as the interpreting crop. Two more houses are now under construction, which, when completed, will make eight of the ten houses necessary to complete the range; the potting shed is being extended to completion, which will make it 200 feet in length; a steam-heated cement hotbed 90 feet in length has been constructed immediately south of the range of greenhouses, to be used for the starting of sweet potato plants and the wintering of various other plants. During the year there were propagated in the houses 1,400 roses, 3,000 carnations, and 8,401 bedding and miscellaneous plants.

LANDSCAPE GARDENING.—The lawns have been extended somewhat and now cover an area of about 12 acres. The parking, 37 feet wide on either side of the entrance drive, has been graded and seeded. The planting of trees and shrubs about the grounds has been continued, 111 evergreens, 31 deciduous trees, and 239 shrubs having been placed during this year. This makes a total now growing upon the lawns of 111 evergreens, representing 68 species and varieties; 151 deciduous trees, belonging to 27 species and varieties; and 360 ornamental shrubs, classed in 52 species and varieties.

NURSERY WORK.—The nursery work has been continued as heretofore. There were grafted during the winter and spring months 1,790 apples, comprising 154 varieties, and 300 pears, consisting of 13 varieties. In addition, 214 figs and 284 shrubs were rooted from cuttings and 1,157 grape seedlings were grown, making a total of 4,166 fruit trees. Besides these, there are now in the nursery 837 bush fruits, 4,104 fruit-tree seedlings for stocks, 8,786 ornamental trees, 1,976 ornamental shrubs, 15,000 privet plants, 60,000 mulberry seedlings, and 6,000 hardy herbaceous perennials.

ORCHARD CULTIVATION.—The variety peach orchard was resown to crimson clover last August, and the heavy crop resulting therefrom was turned under in May of the current year. The orchard has been kept in clean cultivation during the summer and will be resown to crimson clover again this fall. The trees have made a good growth and a number of varieties are bearing fruit this season.

The variety apple orchard was sown to crimson clover for the first time in August, 1907, and matured a heavy crop, which was turned under in May and followed by cowpeas with the hope of securing a crop of cowpea hay in time to again seed to crimson clover this fall. The cultivation and planting in the cover-crop orchard has been continued, as previously outlined. The planting of about 500 apple trees and 400 peach trees has been made for the pathological study of crown-gall and root diseases.

The cranberry work which was just being undertaken at the time of the last report was but partially successful, due largely to the lack of control of the water. This has been remedied and a portion of the block replanted and sanded. The plants are now well established and making a thrifty growth. A small plantation, consisting of about 30 varieties of strawberries, most of which are new and have not yet been fruited or disseminated in this section, has been made for testing purposes. This will be increased as other new varieties are sent in.

SOIL IMPROVEMENT.—The soil-improvement work is being continued along the same lines as heretofore. About 100 acres of cowpeas are being grown and turned under each year. Upon the lands that are now sufficiently improved for the growing of crimson clover the winter crop of rye has been supplanted by crimson clover. A portion of the southwest corner of the farm covering sections A, B, C, and D, from the apple orchard to the southern boundary, was seeded with a meadow mixture consisting of tall meadow oat-grass, orchard grass, and alsike clover in September, 1907, and yielded about 2 tons of hay per acre at harvest.

DRAINAGE.—During the year a large area has been graded and surface drained and about 8 acres tile drained. A portion of two of the large open ditches near the front entrance has been tiled and filled. About 11,000 feet of 2-inch, 760 feet of 4-inch, 2,200 feet of 6-inch, and 1,800 feet of 12-inch tile were laid during the year.

SPECIAL INVESTIGATIONS IN HORTICULTURE.

The miscellaneous investigations conducted in connection with the Arlington Experimental Farm comprise experiments and demonstrations with various truck crops, including the testing of vegetable varieties and the encouragement of school-garden work throughout the country.

TRUCK-CROP SURVEY.—The work of accumulating data upon the time of planting, harvesting, and marketing truck crops is being carried on as in the past, with the hope that we will soon be in position to outline the important zones in which truck crops of a given character can be normally grown to meet the market requirements during definite periods. As soon as this is accomplished the normal acreage for each zone will be studied with the hope that ultimately growers will plant in accordance with normal market requirements, in order that heavy losses from overproduction may be avoided.

The study of field and market conditions upon which the truck-crop survey is based has led to a line of work which involves the improvement and standardization of commercial sorts of vegetables. We now have under way work which will ultimately greatly increase the average profits from cabbage, beets, spinach, and potatoes. The work has already progressed far enough to make this prediction a safe one. While we do not hope for marked results from potatoes, it is believed that the aggregate crop can be greatly increased by carefully selecting seed. During the year the Bermuda onion growing districts of Texas were visited and a study made of the methods followed by the growers.

FERTILIZER EXPERIMENTS WITH TRUCK CROPS.—The difficulties encountered by truck growers through crop failures which could not be attributed to insect enemies or plant diseases led to the inauguration of extensive fertilizer tests in the Norfolk area and upon Long Island in order that reliable information concerning the safe and economical use of commercial fertilizers might be obtained. These tests involve treatments to determine the safety limit in the use of high-grade commercial manures, as well as the limits of the profitable use of these manures to the grower. The work of the year is exceedingly encouraging and results already obtained, while not conclusive, may with profit be used by commercial growers of truck crops. The crops involved in these investigations are potatoes, cabbage, spinach, beans, cauliflower, and asparagus.

POTATOES.—The variety tests with Irish potatoes which have been conducted in cooperation with the State experiment stations of Vermont, West Virginia, and Wisconsin have this season all been centered at Washington. The trials under way this year consist of the Arlington Experimental Farm collection of 140 varieties; returned from Vermont, 64 varieties; returned from West Virginia, 55 varieties; additions to the West Virginia collection, 42 varieties; returned from Wisconsin, 14 varieties; and, in addition to these, 102 European varieties, making a total of 417 different tests. The work with sweet potatoes, especially with regard to storage and varieties adapted to certain localities, has been continued and an excellent variety collection maintained.

RICE-LAND INVESTIGATIONS.—During the past year the work on the rice lands of the South Atlantic coast was continued. As a result of the experiments conducted during the past three years we have been forced to the conclusion that these lands are not so well adapted to the growth of either truck or forage crops as the surrounding high lands. Experiments have been conducted with every crop that would likely prove profitable, with the results previously mentioned. The work has been discontinued for the present.

THE PEANUT INDUSTRY.—Investigations of the peanut industry of the United States have been pursued, especially along the line of better cultural methods and the possibilities of the production of peanut oil. During the year experiments have been conducted along the line of improving the present methods of lifting and harvesting the crop, with the result that at least two machines that will do the work economically are now being used. During the present year it is the plan to continue work along the same lines, especially in cooperation with the Virginia truck experiment station at Norfolk, Va.

VEGETABLE TESTING.—Variety trials and descriptive notes were made of a general collection of garden vegetables, including samples of all obtainable novelties and new stocks. The collections of radishes and garden beets were especially full and complete. The results of similar exhaustive trials of garden beans made during the past five years have been collected and condensed into the form of a bulletin giving full descriptions of all of the distinct varieties of garden beans offered by American seedsmen.

A number of the larger trial grounds of seedsmen and those at different experiment stations, as well as locations where truck crops were largely grown, were visited and notes of the results obtained at these places were made for comparison with those secured at Arlington. The work of devising forms through the use of which comparable variety notes could be made by different observers in different locations has been continued and material progress made. The development of pure stocks of seed of true varietal type for use in the production of seed for the Congressional Seed Distribution has been continued and progress made.

Tests to determine the effect of the local conditions where the seed was grown on the character of the plants produced from it have been continued and satisfactory progress made.

SCHOOL GARDENS.—Owing to the fact that the number of requests for seeds for school gardens increased 33 per cent over the previous year, while the allotment of seed for the purpose remained constant, the apportionment of seed to each school was correspondingly less. It is unfortunate that the number of requests honored does not indicate the number of schools receiving the seeds. About 1,400 requests have been honored, but in many instances these were from superintendents or supervisors who requested seeds for all the schools under their control, so that it is safe to say that at least three times as many schools received seeds as there were requests honored. On this basis the seeds at our disposal were sufficient only to allow nine or ten individual gardens to each of the schools desiring them. The increase in the number of requests received for seeds for school gardens may be taken as a true index of the growing popularity of this character of instruction in our common schools. The distribution this year has been chiefly confined to sets of flower and vegetable seeds for individual gardens. In addition, however, nearly 5,000 sets of decorative seeds have been used, besides 2,000 collections of economic seeds. The distribution of economic seeds for school-garden purposes was an innovation this season. The plan is to place in the hands of teachers samples of seed of the important grasses, cereals, and fiber and forage plants in order that students of one locality may become acquainted with the plants which are staple crops not only in their own locality but in the other important crop areas of the United States. The quantity of seed of each variety was small but sufficient to enable at least 1 square rod of the crop to be grown. It is believed that the growing of this illustrative material will add an important feature to the individual work in the school garden. The economic set sent out this year consisted of the following: American Upland cotton, broom corn, buckwheat, corn, flax, hemp, Kafir corn, millet, peanut, spring barley, spring oats, spring rye, alsike clover, red clover, white clover, Kentucky bluegrass, and timothy.

PLANS FOR FUTURE WORK.—The general policy now in force in the management of the Arlington Experimental Farm will be continued. The great handicap to the work at the farm at the present time is the lack of office and laboratory facilities. The increased number of men engaged in the conduct of scientific investigations at the farm have crowded the present office space and there is no means of providing space for any of the special lines of laboratory work now needed at the farm.

The truck-crop investigations are to be continued along the same general lines as during 1907. Stress is to be placed on special crop studies, including cabbage, potatoes, melons, sweet potatoes, peanuts, celery, cauliflower, asparagus, and horse-radish. The fertilizer work now under way will be continued both on Long Island and at Norfolk. The improvement of seed stock is to be pushed forward as rapidly as possible, and it is hoped that in the near future the whole Congressional Seed Distribution may be based on seed grown from stock produced by the Department.

INVESTIGATIONS IN POMOLOGY.

The pomological work of the Bureau has continued along the lines mentioned in previous reports, the pomological collections being in charge of Col. G. B. Brackett and the field work under the joint supervision of Messrs. William A. Taylor and G. Harold Powell. The progress made during the past year is set forth in the following paragraphs:

POMOLOGICAL COLLECTIONS.

In connection with the pomological collections consultations are held with cooperators and correspondence is conducted with fruit growers relative to better and more systematic methods of fruit culture and the extension of orchard areas. Fruit farms are visited, horticultural societies are addressed, and everything possible is done to aid the fruit grower in solving the many problems which confront him from time to time and which he has been unable to solve. Data on fruit culture are daily being collected and disseminated. The fruit industry of the United States represents an area of 5,000,000 acres, with an annual income of $150,000,000, and advice as to varietal plantings, orchard sites, hardy types, etc., is sought continuously by the fruit growers.

Simplification of fruit nomenclature.—During the year the manuscript on the "Nomenclature of the Pear" was revised and published as a bulletin of the Bureau of Plant Industry. The bulletin met with appreciation at the very outset from pomologists and fruit growers everywhere, and together with the "Nomenclature of the Apple" previously published promises to be the National text-book on nomenclature. No higher, better, or more accurate authority on fruit synonymy exists, and it is a boon to scientist and student alike. Data on the "Nomenclature of the Peach" are being collected and this publication will probably be in print during the next fiscal year. Other publications, such as "Nomenclature of the Plum," etc., will follow in natural sequence in this series.

The revision of the "Catalogue of Fruits" is well under way and will be ready for publication in a few months. This is a list of fruits recommended for the various sections of the United States and the demand for it is very great. The bulletin has been twice revised since 1897, but as there are so many new varieties of established merit since the latest revision (1900), the present revision is imperative, more especially so from the fact that large areas of country have been developed and trade aspects have altered considerably since the former revision. The demands for this publication are urgent and we hope to be able to supply it in the very near future.

Identification of fruits.—Receipts of rare and little-known varieties of fruit have been greater than heretofore, and have amounted to 2,678 during the fiscal year. These fruits have added materially to the usefulness of our collection of paintings and descriptions of previously undescribed subtropical fruits and nuts and have also placed on record many new and promising varieties hitherto undescribed. Within the year 540 descriptions, 431 water-color paintings, 24 models of subtropical fruits, and 73 herbarium specimens have been secured. The reference collection of models, paintings, and descriptions of fruits is the largest, most accurate, and most comprehensive of its kind in the world so far as known.

Cooperation with the Arlington Experimental Farm.—Results from this project have been extremely satisfactory. There are about 25 acres in orchards and about 1,000 varieties of fruits on trial there. Many of these varieties have fruited for the first time this season, and copious notes have been made, which will serve as reference lists for growers of the same varieties in different States. More than 200 promising varieties of peaches are on trial on the farm, and most of them have fruited this season. Of these, paintings and descriptions have been made, as well as records of the relative merits of the varieties; also records of a number of pears, apples, plums, strawberries, etc., that have fruited there this season

Securing a hardy type of peach.—During the year a dozen hardy varieties of seedling peaches, bearing fruit of good quality and appearance, have been sought out and segregated. These varieties represent a season of ripening from July 1 to November 1. They are uniformly of the Chinese Cling group, and from them will probably come a hardy race of peach stocks that will extend the area of successful peach culture several hundred miles north of its present limit. It will also extend the season of ripening fully thirty days.

The extent of the peach area is from Florida to Minnesota and covers five groups of the genus Persica. The present season of ripening is from May 1 to November 1, according to climate and location. But with the addition of this hardy type it is possible to extend the season until December 1. Hardy peach trees have been sent to experimenters in seven of the most northern States, and reports thus far are very gratifying.

FIELD INVESTIGATIONS IN POMOLOGY

The investigations of problems involved in the culture, marketing, transportation, and storage of fruits have continued, as heretofore stated, under the direction of Messrs. William A. Taylor and G. Harold Powell, Pomologists in Charge. The work has proceeded along the general lines followed in previous years, subject to such readjustment and modification as the climatic and crop exigencies made necessary.

FRUIT MARKETING.

The fruit-marketing investigations have continued under the personal direction of Mr. Taylor, assisted by Messrs. G. Harold Powell, L. S. Tenny, H. J. Eustace, G. W. Hosford, and H. M. White. Owing to the abnormal crop conditions which prevailed during the deciduous fruit season of 1907, the work was mainly confined to field studies of methods of handling, the experimental shipment work being suspended until normal crop conditions are restored. In the important eastern winter-apple districts of the Lake Region, New York, New England, and Canada, where the larger part of the crop of the year was produced, an unusually cold and short growing season prevented the fruit of most varieties from attaining normal size, color, and quality. The shortage of the supply of peaches, pears, grapes, and other autumn fruits contributed to the establishment of very high prices for winter apples at harvest time, and this unfortunately was followed by the packing in barrels for shipment and storage of a large proportion of low-grade fruit which would ordinarily have gone to the fruit evaporator and the cider mill. The attempt to market this inferior product, much of which was not evenly graded or packed, resulted in a greatly reduced demand even at the low prices that prevailed from early winter until late in the spring and brought heavy losses to many growers and dealers who stored their fruit.

EXPORT TRADE IN APPLES.—Considering the low average quality of the crop, it is a surprising fact that the trans-Atlantic export movement of apples from the United States and Canada during the season exceeded that of the three preceding seasons and has been exceeded but three times during the twenty-eight years for which commercial statistics of this movement are available, viz, in 1896-97, 1902-3, and 1903-4. The capacity of the European markets to absorb our surplus fruits was thus signally demonstrated and the importance of steady-ing the foreign demand by improving our methods of grading, packing, and forwarding fruits was emphasized.

The experience of the year has resulted in a renewal of interest in the whole subject of grading and packing fruits, especially winter apples, which should result in distinct benefit to the industry.

MISCELLANEOUS INVESTIGATIONS.—In an effort to develop profitable utilization of otherwise unmerchantable apples a cooperative experimental investigation of the practicability of preserving the unfermented juice of suitable varieties of apples in low-priced containers, conducted by Mr. H. C. Gore, of the Bureau of Chemistry, has yielded some very interesting results.

A cooperative investigation of the saki process of removing the astringence of the Japanese persimmon in advance of the softening of the fruit, also conducted by Mr. Gore, needs further prosecution before conclusions can be reached.

Cooperative tests of the practicability of destroying the San José scale on packed apples without damaging the fruit have been made by Mr. A. L. Quaintance, of the Bureau of Entomology.

PECAN INVESTIGATIONS.—Investigation of certain of the numerous problems that confront the pecan growers of the South has been begun under the direction of Mr. Taylor, assisted by Mr. C. A. Reed. Cross-pollination experiments to determine the self-fertility of the leading varieties and the relation of cross-pollination to the setting of the crop, plumpness of kernel, etc., were begun by Mr. Reed during the spring of 1908 at Orange Heights, Fla., and Dewitt, Ga. This work is being done in connection with field studies of the relative adaptability of pecan varieties—a subject of the greatest importance to the industry at the present juncture.

FRUIT TRANSPORTATION AND STORAGE.

The investigations of the transportation and storage of fruits have been conducted during the past year, as heretofore, by Mr. Powell, Pomologist in Charge, assisted by Messrs. A. V. Stubenrauch, L. S. Tenny, H. J. Eustace, S. J. Dennis, G. W. Hosford, C. F. Wheeler, and H. M. White. The transportation investigations have been confined chiefly to the orange industries of California and Florida. The fruit-storage investigations have been conducted in cooperation with the New York and Iowa Agricultural Experiment Stations and independently in New York, Colorado, and California.

CALIFORNIA ORANGE WORK.—The investigations of the causes of decay in oranges in transit from California were continued under the personal direction of Mr. Powell, assisted by Messrs. Stubenrauch, Eustace, Tenny, Hosford, Wheeler, and White. Two hundred and eighty-seven lots of fruit that had been handled in different ways were shipped to New York, where the decay in every package was determined. The object of the shipments was to supplement the data obtained in previous years on the influence on decay of different methods of handling the fruit in the groves and packing houses and of shipping it at different lengths of time after picking and packing. The shipments were duplicated under ventilation and under standard icing. The shipments were made also to secure further data on the keeping quality, after it reached the market, of fruit that had been handled in different ways before shipment.

The results of the shipments and of the market-holding tests in connection with the data of previous years establish conclusively that a sound orange handled in the groves and packing houses with enough care to prevent bruising and shipped soon after picking and packing at the lowest practical temperature will arrive in market sound and keep well after arrival. The decay in transit and on the market is due primarily to the rough handling of the fruit in the groves and packing houses. The shipping tests of the past four years have shown that it is practicable to handle the orange on a large scale with enough care to prevent injury and that the decay can be practically eliminated.

Under the direction of Prof. Charles F. Wheeler an effort was made to determine whether it is practicable to destroy the blue mold spores by using copper sulphate, formaldehyde, or permanganate of potash in the water in the washing tanks. These fungicides were used at various strengths and for various lengths of time, but as a result of a large number of trials their use was not found practicable, the blue mold spores resisting the fungicide in every case. It is fortunate that this is so, as it enforces the necessity of fumigation in scale-infected districts and of careful handling, two fundamentals in successful orange culture.

INFLUENCE OF THESE INVESTIGATIONS ON THE CITRUS INDUSTRY.—These investigations are having a far-reaching influence on the citrus-fruit industry in California. They are said by those most vitally interested in the business to mark the most important epoch in the history of the industry since the sending of the Washington Navel orange to California by this Department in 1873. They have been followed by a general modification of the methods of employing labor in the groves, by the building of new packing houses and the remodeling of old ones, by changes in the business methods of cooperative organizations in the practice of fruit shipment, and by the development of new methods of preparing fruit for shipment. The losses from decay, which formerly varied from $750,000 to $1,500,000 a year, have been reduced at least two-thirds. Of far greater influence, however, is the effect of the work in promoting a wider fumigation of groves, in showing that regions which have acquired a reputation of producing fruit of poor keeping quality can eliminate the decay by improving the methods of handling the crop, in fixing the responsibility for the losses of the fruit while in transit, and in stimulating better methods of handling the citrus-fruit crop in all of its details. This work has had the hearty cooperation of growers, shippers, transportation companies, and receivers from the beginning.

FLORIDA ORANGES.—The Florida orange decay investigation was continued during the winter by Mr. Tenny, assisted by Messrs. Hosford and White. It was conducted in four of the citrus centers of the State to determine the following points: (1) The amount of injury occurring in picking and packing; (2) the amount of decay caused by handling the fruit in different ways in the groves and packing houses after holding the fruit in Florida two weeks; and (3) the decay in oranges handled in different ways in Florida while in transit and after arrival in market.

The amount of fruit injured in picking and packing varied from 1 to 35 per cent, and it was shown that the injuries in picking could be reduced to an average of not more than 1 per cent by efficient labor supervision. The second line of experiments showed an average decay of 2.1 per cent in oranges that were picked carefully and packed without complicated machinery, while similar fruit packed under the usual commercial conditions averaged 20 per cent of decay. Fourteen shipments were made to Washington, where the fruit was held in a common storage room. On arrival the sound fruit graded and sized by hand averaged 0.4 per cent decay, and at the end of two weeks 4.5 per cent; the fruit sized and handled under the ordinary mechanical methods averaged 3.9 per cent on arrival, and 18.1 per cent at the end of two weeks; while the fruit all of which was injured in handling averaged 20.2 per cent on arrival, and 52.4 per cent at the end of two weeks.

The losses in Florida oranges are proportionally heavier than in the fruit from California. They are probably not less than $500,000 a year. These preliminary investigations indicate that the present losses can be overcome by handling the fruit with enough care to prevent mechanical injury. This work is receiving the hearty cooperation of Florida growers and shippers.

Cold storage of table grapes.—The investigation of the cold storage of table grapes and of apples has been continued in California under the direction of Mr. Stubenrauch, assisted by Mr. White.

In the grape experiments 16 varieties were stored under different conditions of handling and of packing. The results indicate that the keeping quality is influenced widely by the methods of handling the fruit. As a typical illustration of the work, the Flame Tokay, when handled and packed under commercial conditions in the ordinary open crate, kept from ten to twenty days; when picked and packed with great care, from forty to sixty days, and when picked carefully and packed with cork filling, from sixty-five to one hundred days. These storage investigations are conducted primarily to determine the factors that influence the keeping quality of western table grapes while in transit to market. They indicate that improper methods of handling the fruit in California are primarily responsible for the losses. These investigations have been urged for several years by growers and shippers and have their hearty cooperation.

California apples.—The apple-storage work in California has been continued, to determine the factors that govern the handling of apples in that section of the country for storage purposes. The principal varieties from the Watsonville and the San Bernardino apple regions have been handled and packed in different ways and were stored in Los Angeles. Through the cooperation of the Bureau of Soils a survey was made of the soil types of the Watsonville area by Mr. W. W. Mackie, as a basis for a study of the influence of the soil on the development of troubles that may arise in the fruit while in storage.

Iowa and Colorado apples.—Under the direction of Mr. Eustace and in cooperation with the Iowa State College, the principal varieties of apples adapted to Iowa have been under investigation in cold storage, especial attention being given to fall and early winter varieties like the Wealthy. The work was extended independently by the Bureau to include the apples of Colorado.

CITRUS-FRUIT STORAGE EXPERIMENTS.—In connection with the citrus-transportation work in California, an investigation is under way to determine the behavior of oranges, lemons, and grapefruit when held under different conditions in cold storage, and also when held in different conditions of common storage. This work is conducted in cooperation with various growers and shippers. The Bureau is under especial obligation to Mr. C. E. Rumsey, of Riverside, who provided special facilities in his packing house for critical work of this nature.

VITICULTURAL INVESTIGATIONS.

As heretofore, the viticultural investigations have been conducted under the direction of George C. Husmann, Pomologist, assisted by Messrs. Alfred Tournier and Fred L. Husmann on the Pacific coast, and in the Rotundifolia investigations by Mr. E. F. Cole during a portion of the year. The correspondence and requests for information show an increasing interest in viticulture, especially with regard to unfermented juice and to table grapes.

WORK AT VINELAND, N. J.—During the past year an agreement has been entered into with the Vineland Grape Juice Company, of Vineland, N. J., for facilities for testing varieties of grapes for unfermented juice. A cooperative experimental vineyard of 8½ acres, consisting of 42 American grape varieties, was established on their place at Vineland, N. J., in the spring of 1908. Through an agreement with the New Jersey Agricultural Experiment Station cooperative fertilizer experiments were started in this vineyard, which will be used also in investigating certain cultural questions and methods of insect and fungous disease control.

Some work in grape pruning, training, and spraying experiments in cooperation with Dr. C. L. Shear, Pathologist, was undertaken on the farm of the New Jersey Training School for the Feeble-Minded, at Vineland, N. J.

TEXAS VINEYARD.—At the South Texas Garden, Brownsville, Tex., 76 resistant varieties, 23 Vinifera varieties on their own roots, and 66 Vinifera varieties grafted on 33 different stocks were planted for observation and study.

ROTUNDIFOLIA INVESTIGATIONS.—In the fall of 1907, unfermented juice was made from fruit of the Scuppernong, Memory, James, Thomas, and Eden grapes at Ronnoc Grove, New Smyrna, Fla., to ascertain the value of these varieties for this purpose. The pollination work done by Mr. E. F. Cole in the spring of 1907 resulted in 1,319 fruits, from which 3,241 seeds were obtained. Plants are now being grown at the Arlington Experimental Farm from these seeds. Under the personal direction of the pomologist in charge, various pruning and training experiments were started at the Medoc vineyards, near Enfield, N. C., and at Ronnoc Grove, New Smyrna, Fla.

To observe their rooting qualities and to obtain plants for further observation and study, cuttings and vines of 45 promising varieties were collected and planted in the cooperative nursery and vineyard on the Pender farm of the North Carolina department of agriculture, at Willard, N. C., 779 seedlings of various crosses grown at Arlington farm last year being planted in the vineyard. The Rotundifolia work at the Pender farm is under the joint direction of the Pomologist in Charge of Viticultural Investigations and Prof. W. N. Hutt, State horticulturist. The field surveys in connection with the Rotundifolia grape work are temporarily suspended on account of lack of needed assistance.

Pacific coast experimental vineyards.—At the Fresno vineyard 134, at Colfax 105, and at Lodi 77 table-grape varieties grafted on resistant stocks have been set, and at Oakville 5 and at Stockton 20 additional resistance and direct producers have been planted. The number of congeniality tests between Viniferas and resistants has been increased by grafting more Vinifera varieties on additional representative resistant stocks. The older resistants and direct producers and grafted vines in the experimental vineyards are now giving data of definite nature on their adaptability to special conditions. These data are supplemented by observation of varieties in commercial vineyards.

In the fall of 1907, 522 acid and saccharine tests were made from varieties in the Oakville vineyard, and 293 were made in the Fresno vineyard. One hundred and fifty-two authenticated seed samples of grape varieties were collected in the Oakville and 81 in the Fresno vineyard. Additional photographs were made of the vines of 45 varieties, of the leaves of 63, and of the fruit of 73 varieties. Additional detailed descriptions were made of vines of 57 varieties and of fruit of 44 Vinifera and 41 direct producers, from varieties in the experimental vineyards. Distributions of vines and cuttings were made to private investigators as follows: Plants of 72 Vinifera varieties grafted on 38 resistant stocks grown in nursery experiments; plants of 96 resistant varieties and cuttings of 112 Vinifera and 48 resistant varieties. At the Oakville vineyard, cuttings of 158 resistant varieties and 150 varieties from the Fresno vineyard have been planted in the nursery to test their relative rooting qualities.

FRUIT DISTRICT INVESTIGATIONS.

The fruit district investigations have been continued in charge of Mr. H. P. Gould, Pomologist, assisted by Mr. W. F. Fletcher. The work has been conducted along the same lines as in former years, but has been extended in several important directions. Three new projects have been added to those previously reported. The more prominent features of the past year's work are indicated in the following paragraphs:

Adaptability of fruit varieties.—The work in this connection has been primarily a continuation of projects which had previously received some attention. On account of favorable crop conditions in certain portions of the Ozark region of Missouri, Arkansas, and Oklahoma, field work in connection with the study of the adaptability of peach and apple varieties in that region was more extensive and satisfactory than in any previous season. Similar work regarding early apple varieties was prosecuted in eastern Virginia and North Carolina. This work is in connection with the study of the early apple industry of the Coastal Plain region, which is becoming of considerable importance. A large amount of data relative to the conditions in these regions and the behavior and relative value of the different varieties of fruit in cultivation are being accumulated.

It is expected that it will be possible to complete the investigations in these regions in the near future, when reports thereon will be prepared.

PHENOLOGICAL INVESTIGATIONS.—As in previous years, this work has been confined mostly to apples, pears, peaches, plums, and cherries. It has been considerably extended during the past year by a large increase in the number of voluntary observers in different sections of the country and in the broadening of the work in other ways. Each season's records add a large amount of valuable data to that on file, but it is believed that the work should be continued several years longer before extended correlation is attempted.

An extensive series of self-pollination and cross-pollination tests of several of the leading commercial varieties of apples is in progress to determine (1) whether any of these varieties are self-sterile and (2) which varieties are best adapted for cross-pollinating such sorts. This work has an important bearing upon the selection of varieties of apples for planting together in commercial orchards.

DRY-LAND FRUIT GARDEN.—In cooperation with the Office of Dry-Land Agriculture Investigations, a fruit garden is being established at the substation at Akron, Colo. The first plantings were made the past spring (1908) and include 11 varieties of apples, 8 of pears, 2 of peaches, 4 of plums, 2 of cherries, 14 of grapes, and about 25 varieties of different kinds of small fruits, including gooseberries, currants, raspberries, blackberries, and strawberries. Besides these fruits there has been planted a considerable number of Russian olive, honey locust, black locust, and Russian mulberry trees to form a wind-break about the garden. The object of this work is to determine what varieties and what methods of culture are adapted to the production of a home supply of fruit in this section of the Plains region. In most cases but two trees of each variety of the orchard fruits and six plants each of the small fruits have been planted. It is expected that the number of varieties will be somewhat increased by future plantings.

WESTERN ORCHARD MANAGEMENT.—As there are several important cultural problems confronting the growers in the region between the humid and semiarid portions of the Middle West, work has been begun on some of these at Hutchinson, Kans., in cooperation with the Yagy Plantation Company. The work has not yet progressed far enough to report results.

FRUIT CANNING AND CIDER MAKING ON THE FARM.—Considerable attention has been given these subjects the past year, especially the methods of utilizing surplus and otherwise unsalable fruit by canning it. Increasingly frequent requests for information are received, and it is hoped that it will be possible to supply this in printed form in the near future.

PLANS FOR FUTURE WORK.

FRUIT MARKETING.—The resumption of experimental shipments of early apples, peaches, and certain other fruits is contemplated as soon as suitable equipment for precooling the fruit is available. It is hoped that an investigation of market conditions in some of the European markets can be made. A continuation of the studies in apple grading and packing is contemplated. The cooperative work with the Bureau of Chemistry on the utilization of surplus fruits will be continued; also that upon the saki treatment of Japanese persimmons.

FRUIT TRANSPORTATION AND STORAGE.—The transportation problems connected with the table-grape industry of California and the citrus work of Florida will be enlarged. The California orange-transportation work will be continued on a smaller scale than formerly. The cooperative work in fruit storage will be continued with the New York State Experiment Station. The Colorado apple-storage work will be discontinued temporarily. The citrus-fruit storage work will be continued with oranges, lemons, and grapefruit, and the transportation experiments will be extended to the lemon industry in California. Technical investigations in the cooling of fruits for transportation will be conducted by means of the portable refrigerating plant which is now under construction

FRUIT DISTRICT WORK.—As all the lines of investigation require still further attention, no new projects are contemplated at present. In several particulars the work now in progress requires strengthening and further extension. So far as possible this will be done. The study of the adaptability of fruit varieties, which constitutes the central feature of the fruit district investigations, will be extended into other well-defined geographical regions when the work in the Coastal Plain and Ozark regions is completed.

VITICULTURAL INVESTIGATIONS.—The problems under investigation will be continued and enlarged. The accumulation of data on the varieties in the experimental vineyards will be continued. Detailed descriptions will be made of varieties not heretofore described. Congeniality study of Viniferas on diverse resistant stocks will be pursued. Experiments in wood selection and special pruning of certain varieties, additional inoculation of vines with phylloxera, and fertilizer experiments are contemplated in the Pacific coast experimental vineyards. Pruning, training, and fertilizer experiments will be pursued at the Vineland experimental vineyard. In cooperation with the Bureau of Chemistry, experiments with unfermented juice from Rotundifolia varieties will be undertaken. It is the intention to plant at Willard, N. C., for comparison and study, the seedlings of Rotundifolia obtained from pollination experiments made last year, as well as to set out in the experimental vineyard the plants obtained from cuttings of varieties planted in the nursery at Willard, N. C.

PECAN INVESTIGATIONS.—As comprehensive a study as practicable of the bearing pecan orchards of the South is contemplated with a view to determining the behavior of the leading varieties in the principal sections where pecan orchards are being planted. The cross-pollination work will be duplicated and enlarged during the coming season.

GREENHOUSES, GARDENS, AND GROUNDS.

The work connected with maintaining and caring for the Department grounds and gardens has continued in charge of Mr. E. M. Byrnes, Superintendent. During the year there were propagated and distributed 111,253 plants, representing 84 species and varieties. In connection with the greenhouse work, Mr. George W. Oliver, Expert, has continued his experiments in the hybridization of plants. Following is a brief summary of the work of the year:

GREENHOUSE CONSTRUCTION AND REPAIR.—A new greenhouse 13 feet 3 inches wide, 142 feet 6 inches long, and 10 feet high, two brick frames 6 feet wide, 142 feet 6 inches long, and 3 feet high, and one brick frame 7 feet wide, 142 feet 6 inches long, and 3 feet high were constructed on the north front of the Department grounds east of the present range of greenhouses at a cost of $1,940.85; seven badly decayed wooden benches were removed from the greenhouses and replaced with one iron and terra-cotta bench and six cement solid beds. Such repairs were made to the old greenhouses as were necessary to keep them in a temporary serviceable condition. Eleven greenhouses were given a coat of paint inside and outside. The two steam boilers heating the old range of greenhouses and office rooms of the Bureau were overhauled, cleaned, and painted. A stable to accommodate four horses was constructed at the end of a storage shed on the north front of the Department grounds at a cost of $130. The old frame stable on the south front of the west wing of the new building, an old sash greenhouse 12 feet wide and 100 feet long, and a frame potting and storage shed 20 feet wide and 200 feet long on the north front of the building were taken down and removed. One hundred and eighty-four square yards of granolithic pavement were laid on the south front of the greenhouses located on the northern portion of the Department grounds at a cost of $211.60.

GREENHOUSE OPERATIONS IN THE NEW RANGE.—There are 16 houses in this range devoted to the following work: The propagation of plants and fruits collected by the Office of Foreign Seed and Plant Introduction; seed testing, tea culture, and medicinal plant investigations; experimental work of the offices carrying on pathological and physiological investigations, as well as for other branches of the Bureau; the propagation of plants for ornamenting the grounds; the growing of plants for distribution and for ornamenting the grounds of the Weather Bureau; experimental work with vegetables; experimental work with florists' crops, for which the following plants were grown: 1,760 roses in 7 varieties; 5,863 carnations in 18 commercial varieties, and 580 seedling plants resulting from crosses made during the past winter; 2,370 chrysanthemums in 238 varieties and 120 seedling plants, which are the result of crosses made last autumn. The chrysanthemums were grown for our annual show, which was opened to the public on the morning of October 30 and was closed on the evening of November 7. Great interest was taken in the exhibition by the public. After the show was closed the flowers were cut and distributed to all the hospitals in Washington, D. C.

GREENHOUSE OPERATIONS IN THE OLD RANGE.—There are six houses in this range, four of which are devoted to the experimental work of the offices conducting pathological and physiological investigations, to a collection of 81 varieties of European grapes, to a collection of citrus and other tropical fruits, and a collection of tropical and economic plants. Two small houses have been allotted to normal schools Nos. 1 and 2, of Washington, D. C.

GENERAL IMPROVEMENTS IN THE GROUNDS.—One hundred and forty square yards of asphalt roads were repaved; 2 young evergreen and

3 deciduous trees were planted in the grounds, to replace a like number which had died during the winter; 56 ornamental and flowering shrubs were added to the collection in the grounds; the terrace slopes around the new Department buildings were surfaced with good top-soil and sodded; during the season the lawns were mowed and edges trimmed as often as required to maintain them in good condition; the asphalt roads and walks were swept daily and the macadam roads were watered daily during dry weather; dead branches were removed from the trees and shrubs; the shrubs and hedges were pruned as often as required, and the walks and roads kept free from weed growth; some portions of the lawns were top-dressed with 250 cubic yards of well-decomposed stable manure and the remainder was given a dressing of commercial fertilizer; bare spaces on the lawns were forked and seeded in grass.

Ornamental planting in the grounds.—Collections of 12,360 hyacinth, tulip, and narcissus bulbs of standard sorts and 3,500 pansy plants were planted in beds in the autumn for display in the early spring; 19,407 bedding plants in 57 species and varieties and 630 tropical plants in 30 species and varieties were planted in beds in the spring. There were also planted in our trial grounds a collection of hybrid grasses for testing.

Hybridization of plants.—The lettuce selections from the large number of varieties raised by hybridization are very promising. The types selected include heading and bunching forms. These will be tested in different parts of the country in the near future. The same method used in crossing the lettuce has been used successfully with other genera of the Compositae, notably the dahlia. Many forms have been raised by using the new *Dahlia chisholmii,* introduced by the Department recently, as the seed bearer. This has been crossed with several of the best varieties of other species. Earliness and profusion of bloom are the chief characteristics of the new hybrid. All colors of the genus are represented in this season's plants except pure white. Other florists' flowers of this order which have successfully crossed by the new method are the chrysanthemum, zinnia, and helianthus, a hybrid between *Helianthus argyrophyllus* and *H. cucumerifolius* being particularly promising.

Hybrid forage grasses.—The hybrid forage grasses, comprising 10 distinct forms resulting from crossing Texas bluegrass with Kentucky bluegrass, were propagated vegetatively and given a test in the open field under exceedingly unfavorable conditions. Three of these forms were very satisfactory, one plant producing 500 per cent more foliage than either parent on the same space. This form has the rootstocks well developed and is evidently quite drought resistant.

Miscellaneous hybridization work.—Requests having been made to the Bureau by onion-seed growers to ascertain what could be done in breeding from what appeared to be mildew-resistant individuals in different varieties, a number of bulbs from apparently immune plants were secured, flowered, and crossed. The first generation progeny is quite varied. These will be given a trial in California the coming season.

The celery seed secured last season, resulting from cross-pollinating some of the well-known kinds, germinated well this season. The plants are now quite vigorous and already show signs of hybrid parentage.

In the cowpea work one of the hybrids raised two years ago was satisfactory in every way, except that only about 10 per cent of the plants were early seeding. Selections made from these early-seeding plants are coming very even this season, with promise of a heavy crop.

The tomato work, consisting of raising new forms for forcing purposes, is gradually producing satisfactory results, and in a year or two it is hoped that a fruit will be produced in which there will be no waste.

Among other lines of breeding work which have been started are the production of a rust-resistant asparagus, the improving of the huckleberry by selection and hybridization, the securing by hybridization of a hardy evergreen hedge plant for the Northern States, and the production of a race of pansies more suited to our hot summers than the European varieties.

ESTABLISHING THE EASTER LILY BULB INDUSTRY.—During the past season the work of establishing the Easter lily bulb industry in the southwestern portion of California has made rapid progress. One firm has about 3 acres in cultivation and the coming season expects to have from 15 to 20 acres. The true *Lilium harrisii* has practically been eliminated from the trials, as there is some physiological weakness in it that evidently can not be overcome. Crosses between this variety and others have turned out very satisfactorily. Seeds of the black-stemmed variety known as giganteum and the variety multiflorum have been raised and distributed to growers who have shown an aptitude for the work. It has been found that a marketable lily bulb can be raised in California in one year from the date of setting out the small seedlings.

WORK DURING THE ENSUING FISCAL YEAR.—It is proposed during the ensuing fiscal year to build two greenhouses 142 feet 6 inches long, 20 feet wide, and 14 feet high; to give four greenhouses a coat of paint inside and outside and give a coat of paint to the roofs of the building 297 feet 7 inches long and 22 feet 3 inches wide on the north front of the new range of greenhouses, and to two storage sheds each 142 feet 6 inches long and 20 feet wide, adjoining the new range of greenhouses; to grade the ground surface with good soil, to sod around the new buildings, and to resurface the macadam roads. The hybridizing experiments with florists' crops and vegetables, together with the propagation of trees, plants, and shrubs, will be continued along the same lines as last year.

FARM MANAGEMENT INVESTIGATIONS.

The farm management investigations have continued under the direction of Prof. W. J. Spillman, Agriculturist, along the same general lines as during the previous year. The work has been considerably broadened in many respects since the last report on these investigations, which was made two years ago. The work was not covered by the last report, so that the following chapters form a résumé of the work of the past two years. The farm management investigations are subdivided into four general heads, viz,armpr management districts; farm practice; farm economics; and range and cactus investigations. Following is a brief report of the progress made in these different branches of the work:

FARM MANAGEMENT DISTRICTS.

Ten farm management districts are now in full operation, four ot which are located in the cotton belt. The work of these latter districts, Nos. 1 to 4, is so closely allied in its agricultural interests that it seems advisable for those in charge in these separate districts to work together as much as possible on the same problem, especially where the problems are not confined to the limits of one district. Where problems are confined to district lines the men in charge work them out independently.

The farmers' institute continues to be a part of the work, and calls are frequently made to cooperate with the State departments of agriculture, the State experiment stations, and during the past year to a considerable extent with Congressmen in their individual districts. In Arkansas the appropriation last year of a farmers' institute fund relieved this office of the responsibility of this work, although our men continue to assist the State authorities whenever requested to do so.

GENERAL WORK IN THE COTTON BELT.—The winter legumes are being established as fast as the means at hand will allow, the principal ones being red clover, crimson clover, bur clover, hairy vetch, common vetch, and a southern vetch, *Vicia microcarpa*. This latter ripens its seed the latter part of March and the first of April, and if it proves to be adapted to cultivation it will be of the greatest value as a winter legume, especially on cotton farms, since its seed ripens at a time when it can be harvested or plowed under in plenty of time for any crop that is to follow. Red clover is also proving in many instances to be of great value as a winter cover crop, and it now seems as though we have yet much to learn in regard to its proper place in the South. The fact that vetch seed can be produced in the South would indicate the possibility of supplying the market with domestic seed and should tend to bring the price down to a point where the farmers can better afford to grow it.

Special attention has been given to the extension of the cowpea, not only as a soil builder but as a hay and a seed crop. Considering the fact that cowpea hay, after the seed has been thrashed, brings a higher price on the local markets where it has been tried than the unthrashed hay, that the price of seed has ranged during the last three years from $1.25 to $4.50 per bushel, and that at times it is impossible to procure it at any price, it would seem that these figures should overcome in a great measure the established idea that cotton is the only safe money crop. The improvement of suitable machinery for separating the cowpea is now such that this legume should at once be placed in a more dignified position in our southern agriculture.

FARM MANAGEMENT DISTRICT NO. 1.—Since the last report Mr. Harmon Benton, who had charge of this district, has resigned, and it is now in charge of Mr. C. L. Goodrich. A large part of Mr. Goodrich's time has been spent in making an agricultural survey of Florida, as this State has been given little attention heretofore. The great freeze of 1895 marks an epoch in Florida agriculture, as it was the beginning of a more diversified system of farming. While citrus groves are still prospering to a certain extent in some localities, the trucking industry has greatly developed in certain parts of the State, the principal truck crops being strawberries, Irish potatoes, lettuce, and celery. These are located about central points, and each has developed its own peculiar system of irrigation, fertilization, and cropping. There are three systems of irrigation, namely, the ditch and furrow, subirrigation, and overhead spray system, the latter also known as the Skinner system. In this there is great room for improvement, as the amount of water used varies widely and in many cases serious damage is done to the crops by an unintelligent use of the water. The same thing is true of the fertilizers, these being applied at rates varying from half a ton to 7 tons to the acre of concentrated fertilizers, no definite knowledge of the amount necessary apparently existing. In many cases, were it not for the excessive use of water, the crops would be damaged greatly by the large amounts of fertilizers. There is great need for more definite information regarding the proper amount of water necessary and the proper use of commercial fertilizers.

In all the cropping systems the velvet bean is the principal soil renovator and in fact occupies the place the cowpea now holds in States farther north. Mr. Goodrich gives also a very full report on his investigations of the subject of stock raising and the production of forage crops. A very valuable report on hay production on a farm in South Carolina is given by Mr. Benton in Farmers' Bulletin 312. In South Carolina, demonstration work has been established in each of the Congressional districts. The work consists of the growing of the winter legumes in cotton and in rotation with other crops for the purpose of showing their value as cover crops to prevent the washing of the soil during the winter, as forage and hay crops, and as soil builders, as against the exclusive use of commercial fertilizers.

FARM MANAGEMENT DISTRICT NO. 2.—The work in this district has been continued along the same lines as in previous years. The farm at Uniontown, Ala., mentioned in Farmers' Bulletin 310, is still being run along the same lines and is causing widespread attention. Results since the publication of this bulletin have been even more striking than those already published. As a result, an increasing amount of alfalfa is being planted each year on this type of soil, and the production of hogs is on the increase. The work on the Huntsville farm has demonstrated that alfalfa can be successfully grown in the Tennessee River Valley. The use of bur clover as a winter cover crop has attracted wide attention. It gives most satisfactory results in a rotation with corn and cotton. The Talladega farm has attracted much attention with its rotation, thorough tillage, and the use of improved implements, and the methods here employed are being copied by other farms. In this district bur clover is being used much more generally than heretofore, and there is an increased demand for the seed. This makes the production of bur clover seed very profitable, aside from its value as a cover crop.

FARM MANAGEMENT DISTRICT NO. 3.—Owing to the resignation of Mr. C. K. McClelland the work in this district suffered greatly before a successor could be obtained. This work is now in charge of Mr

A. D. McNair, who began his duties about the first of the year. He has taken up the work as Mr. McClelland left it and the growing of winter legumes is being pushed with more vigor than ever. In De Soto Parish, La., interest has centered on the vetches as a winter cover crop, and these are being well established at that point. The work at Thornton, Ark., is being conducted along the same lines as last reported and is becoming of greater interest to the farmers, and there is a marked improvement along the lines of more diversified farming in Calhoun and adjacent counties. The work on the farm of Mr. J. M. Walker, at Latour, Ark., has been published in Farmers' Bulletin 326. The growing of cowpeas for both hay and seed and the establishment of the winter cover crops still occupy interesting places on the farm. Mr. McNair is carrying on various tests for curing hay, a very essential matter in this moist southern climate. This work is being conducted on the farms of individual cooperators throughout the territory.

FARM MANAGEMENT DISTRICT No. 4.—This district also suffered by the resignation of Mr. C. W. Warburton and also from the long delay that ensued before the place could be filled. The work is now in charge of Mr. B. Youngblood, who has taken up the work as nearly as possible where Mr. Warburton left it, and is conducting it along essentially the same lines. A new feature of his work has been the demand from various high schools of the States of Texas and Oklahoma for cooperation in establishing the study of agriculture in their schools and in planning the work on their school farms. During the present summer Mr. Youngblood is giving special attention to the semiarid part of his district. He is studying the methods of those farmers who have succeeded over a long period of years. The results of his study are believed to be of sufficient importance to justify their publication in the near future. In this work Mr. Youngblood is being assisted during the present season by Mr. M. M. Offutt.

FARM MANAGEMENT DISTRICT No. 5—NEW YORK AND NEW ENGLAND.—The investigations in this district are conducted by Mr. L. G. Dodge. During the past year special attention has been given to cropping systems for dairy farms and to potatoes as a farm crop. Dairying is the most important type of farming in New England and in much of New York State. Formerly the business was quite profitable, but during the past few years the high price of grain and mill feeds and the scarcity and high price of farm labor, together with unfavorable market conditions, have made the business much less remunerative, many dairy farms being conducted at a loss. At present the only means of overcoming the difficulties mentioned seems to be more economical production of milk. To do this herds must be improved and a better quality of feed produced. In some cases part or all of the necessary grain may be grown on the farm. For this purpose a mixture of peas and oats or of barley, peas, and oats may be grown, one year in a four-year rotation being devoted to these crops. The production of a good quality of leguminous hay, such as pea and oat and clover hay, reduces the quantity of expensive grains necessary. Mr. Dodge has given special attention to the cropping systems used on a large number of the best dairy farms in his district. The results of his study of this subject are embodied in a Farmers' Bulletin entitled "Cropping Systems for New England Dairy Farms," the manuscript of which is now in the printer's hands.

Next to dairy farming, if we leave out of consideration the production of hay for market, a type of farming entirely too prevalent in New England, potato growing is most important. The potato crop is especially prominent in Aroostook County, Me., and is becoming more and more prominent in other parts of this district. The study of farm practice on farms growing potatoes as a major crop has continued, and it is hoped that the results of this study may be put into bulletin form during the current year.

Other types of farming, such as the production of forage for swine and sheep and the culture of apples, an industry much neglected in New England, have been studied during the year. A good many working plans for farms have been made, and the demand for assistance of this kind is growing rapidly. It is proposed to hold several field meetings during the year on farms in the district which show leading types of farming as they should be conducted. These meetings will be held in conjunction with State authorities in all cases.

FARM MANAGEMENT DISTRICT NO. 6—PACIFIC NORTHWEST.—The work in this district, as in former years, has been conducted by Mr. Byron Hunter. The boundaries of the district have been modified so that it now includes Oregon, Washington, Idaho, and northern California. Most of this territory is yet in the exploitive stage of farming characteristic of all newly settled regions. The earliest settlements were made in western Oregon, where wheat raising became the prevailing type of farming. Beginning about 1845, wheat became the almost exclusive money crop of this region. It required about fifty years of exploitive farming to drain the rich soils of the Willamette Valley of their fertility. About 1895 a movement toward diversified farming became general, dairying and fruit raising becoming especially prominent in the valley at that time. The general introduction of dairying and other types of live-stock farming brought grasses and forage crops into prominence. Mr. Hunter has continued to give special attention to this class of crops for western Oregon and western Washington. Largely as the result of his efforts thousand-headed kale during the past year has become a leading forage crop in this section. This crop takes the place of siage on dairy farms, and is also an excellent feed for beef cattle, hogs, and poultry. It yields more feed to the acre than corn, and the proportion of protein in kale is considerably higher than in the latter crop.

In northern California the problems now confronting the wheat grower are similar to those with which the western Oregon farmer had to deal ten years ago. A beginning has been made of a study of farm practice in that section with a view to ascertaining the types of farming which may replace continuous wheat growing.

The region east of the Cascade Mountains in Oregon and Washington and in the northern part of Idaho consists of a comparatively small area of irrigated land on which alfalfa growing, stock raising, and fruit culture are the prevailing types of farming, and a much larger area of upland prairie which until recently has been devoted almost exclusively to the small grains, especially wheat. In this region grain growing, having continued only thirty to thirty-five years, has not yet depleted the soil sufficiently to warn the farmer of the certain result of soil exploitation.

At the present time the wheat grower has two pressing problems. One of these is the spread of weeds adapted to growth in grain fields. Wild oats early gained a foothold in the wheat fields and have frequently reduced the yield of wheat very materially. Russian thistle and prickly lettuce were introduced a few years ago, and numerous other weeds have become established more or less locally. The worst weed, however, which has ever made its way into this region is a species of mustard, which during the past few years has spread rapidly and renders it difficult to harvest the grain because of the tall, coarse stems, which interfere with the operation of harvesting machinery. During the past year Mr. Hunter has given special attention to farm practice in dealing with this weed. He finds that it usually germinates in the fall and is thus especially detrimental to fall-sown grain. A few farmers have been able to overcome the difficulty by repeatedly harrowing the wheat fields in the spring. This treatment uproots the mustard without seriously injuring the grain. The method is recommended as worthy of trial throughout the region.

Other weeds in this section are receiving attention, and such problems as the finding of suitable varieties of winter grain, forage crops for hogs, and the use of fertilizers are being closely studied. In western Oregon it has been found that the application of land plaster (calcium sulphate, or gypsum) in quantities as small as 40 pounds to the acre causes red clover to yield abundant crops, where otherwise this crop frequently fails or produces unprofitable yields. The ordinary implements used in distributing fertilizers can not be made to distribute such small quantities, hence the work is commonly done by hand. Not only is hand sowing an extremely unpleasant task, but by this method it is well-nigh impossible to distribute so small a quantity of land plaster evenly. While studying methods used in distributing plaster, three farmers were found who had invented simple and inexpensive implements for this purpose. A description of these implements and the method of using them has been prepared by Mr. Hunter and will be published in the near future by the Oregon Agricultural Experiment Station.

FARM MANAGEMENT DISTRICT No. 7—THE MIDDLE WEST.—When the Middle West was newly settled and exploitive systems of farming were possible the business was sufficiently attractive to hold the farmers' sons on the farms. Those who could not find room on the home farm took homesteads farther west or went to the city; but homesteads are no longer available and the old types of exploitive farming no longer yield attractive returns. The newer methods of farming do not furnish the easy returns that formerly made the business so attractive. The lack of instruction in agricultural matters in the public schools has worked to send the farmers' sons into the so-called learned professions and other city occupations. The older men are retiring, leaving the business to tenants, yet the price of land continues to advance. The position of the young man with no capital but his energy who wants to own a farm home is growing more and more difficult. He must pay a high price for land, find capital to equip it, and follow a conservative type of farming. These conditions render it imperative that systems of farm management be carefully studied and made known to ambitious young men who desire to acquire farm homes. Mr. J. A. Warren, whose district consists of the States of Missouri, Iowa, Nebraska, Kansas, eastern Colorado, and Wyoming, has given special attention during the past few years to the problems of men of this class. His bulletin, entitled "Small Farms in the Corn Belt" (Farmers' Bulletin 325), is an attempt to show how a few men have succeeded in acquiring homes and making comfortable incomes on small farms in sections of high-priced farm lands.

The extreme western part of this district lies in the semiarid region. Except in a few localities the land homesteaded in the semiarid region twenty years ago has been largely abandoned. During the present summer Mr. Warren is putting his whole energy into a study of the conditions in the semiarid part of his district. He is giving special attention to the methods of those farmers who have succeeded for a long period of years. The results of this study are believed to be of sufficient importance to justify their publication in the near future.

FARM MANAGEMENT DISTRICT NO. 8—VIRGINIA, MARYLAND, AND DELAWARE.—The work in this district is being conducted by Mr. H. A. Miller. The district contains several distinct geographic sections in which the prevailing types of farming differ widely and the problems of the farmer differ correspondingly. In western Virginia and northern and western Maryland, Kentucky bluegrass grows more or less abundantly. In most of this bluegrass region steer feeding is a prominent industry, and while the returns to the acre from land devoted to this business are small, the system maintains the fertility of the soil. On large farms steer feeding is a satisfactory business. The worst fault of farm practice in the steer-feeding sections is the length of time meadows are left down. The rotations are too long to secure the greatest income from the land.

In a considerable portion of the bluegrass region, especially in the Valley of Virginia, raising timothy hay for market is a leading phase of agriculture. In this section meadows are left down year after year, with no attention paid to the fertility of the land, until the yield of hay becomes unprofitable and the quality poor because of weeds. As soon as the opportunity presents itself demonstration work relating to the management of hay lands in this section will be undertaken.

In eastern Virginia and southern Maryland the systems of farming differ widely from those in the region just described. As in other parts of the district, farm labor is scarce and generally unreliable in character. In southeastern Virginia the greatest peanut-growing region in the United States is found. Here the soil has been greatly depleted by the continuous growing of peanuts. Although this crop is a legume, and might thus be presumed to aid in maintaining a supply of nitrogen in the soil, the fact that in harvesting the crop even the roots are pulled and removed from the field destroys whatever value the crop might have as a soil renovator. There seems to be an excellent opportunity for the Department to do effective work in the peanut section, as the best farmers are beginning to realize the importance of soil improvement and the value of a crop rotation that includes legumes. There have been many calls for advice from farmers in this district during the past year, and a number of working plans for farms have been made. The movement from the city to the country is affecting this district materially, many city people having bought farms during the past year. The cheap lands in the tobacco section have also attracted farmers from the high-priced lands of the Middle West.

FARM MANAGEMENT DISTRICTS NOS. 9 AND 10.—The work in District No. 9, which includes Pennsylvania and New Jersey, was interrupted during the past year by the resignation of Mr. Lyman Carrier. He was succeeded by Mr. George A. Billings, who has begun a study of farm practice in this district. District No. 10 is now being organized and includes the States of Illinois, Indiana, Ohio, Kentucky, and West Virginia. The work in this district has been placed in charge of Mr. J. A. Drake.

FARM MANAGEMENT DISTRICT NO. 11.—This district includes the States of Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota. The work was begun during the past year, the services of Prof. J. C. McDowell, of the North Dakota Agricultural College, having been secured for that purpose. For reasons already stated in connection with District No. 7, Professor McDowell has devoted his entire time thus far to a study of agricultural conditions in the extreme western, or semiarid, portion of his district. The scarcity of farm land has led to the general settlement of these dry areas in recent years, and the need for information about dry-land farming is imperative. A careful study is being made of dry-farming methods, and especially of the soil types suited to agriculture in this region.

In the eastern States of the district, especially in the northern sections, there are large areas of poor, sandy land known locally as the "jack-pine plains." Although many settlers have located on these lands during the last twenty years, most of them have failed and abandoned their holdings. A few, however, have worked out the problem of redeeming these lands. During the past two years Mr. C. B. Smith, of this office, has made a study of the production of clover seed in the jack-pine plains region, the results of which have recently been published.

FARM PRACTICE INVESTIGATIONS.

In addition to the general study of systems of farm management outlined in the foregoing, the Office of Farm Management Investigations has a number of representatives assigned to the study of specific phases of farm practice. This work is under the general direction of Mr. C. B. Smith. The most important phases of these studies are briefly described in the following paragraphs:

HAY AND HAYMAKING.—Mr. H. B. McClure, assisted by Mr. L. G. Connor, is making a study of the production, curing, handling, and marketing of hay. In many parts of the country hay is sold by measurement instead of weight. We have already developed an accurate rule for determining the number of cubic feet in a rick of hay and are now studying the relation between weight and volume. It has been found that the weight to the cubic foot depends on the kind of hay and its condition at stacking time, the height of the stack, and the length of time the stack has stood. Results secured from the measurement of several hundred stacks which were subsequently weighed indicate that the solution of this problem is feasible, and it is hoped, by the end of the present season, to furnish data by which a fairly accurate estimate of the weight of hay in a given volume can be made.

During the past year investigations have been made to ascertain the amount of loss occurring in hay stacked out of doors in the State of Missouri. Timothy hay lost 20 per cent by December and 60 per cent by April. Prairie hay lost 30 per cent by December. In other words, the percentages of hay mentioned became unmarketable by exposure to the weather. These figures indicate that in the East a great saving could be made by putting hay under cover. Artificial methods of curing hay are also being tested. Artificially cured hay is worth two or three dollars more a ton on the market on account of its color and aroma. Experiments are under way in order to determine the most practicable methods of artificial curing.

MANURES AND FERTILIZERS.—The study of farm practice in the use of manures and fertilizers has been continued during the past year by Mr. J. C. Beavers. Particular attention has been given to farm practice in the use of commercial fertilizers in the Atlantic Coast States, where fertilizers are more largely used than elsewhere. Our observations are not yet extensive enough to permit deductions of wide application. It has been found, however, that farmers working independently of each other have come to the general conclusion that potash and phosphorus fertilizers are both needed in considerable quantities on the sedimentary soils of the Coastal Plains region, while on the Piedmont Plateau, where the soils have been formed from the decay of rocks in place, a much smaller quantity of potassium and about the same amount of phosphate as is used in the Coastal Plains region are generally applied by the best farmers. On the black prairie soils of Alabama and Mississippi neither phosphorus nor potassium gives any response, but nitrogen is highly effective. This nitrogen may be supplied by growing leguminous crops on this soil, which is eminently adapted to alfalfa. The potato growers, both in Maine and New Jersey, where large areas are devoted to this crop, use from 1,200 to 1,500 pounds to the acre of fertilizer containing 3 to 4 per cent of nitrogen, 6 to 7 per cent of phosphoric acid, and 8 to 10 per cent of potassium. It has also been shown that lime is very beneficial practically throughout the Coastal Plains region.

CORN CULTURE.—Mr. C. E. Quinn, of this office, has paid considerable attention to the subject of corn culture, data being secured on both field and pop corn. Especial attention has been given to the Williamson method of corn culture in the South. The men who are following the Williamson method are getting increased yields of corn. It can be said for this method that the extra preparation of the soil and cultivation of the crop, together with the cowpeas and the cornstalks that are annually turned into the soil, are sure to improve agricultural conditions in the South.

FORAGE CROPS FOR HOGS.—During the past year Mr. Quinn has also made an extensive study of the production of forage crops for hogs in Kansas and Oklahoma. A number of important facts have been learned in this study. Throughout this territory alfalfa is utilized as a summer pasture for hogs. It is available from April ot November. On good upland, alfalfa carries 10 hogs to the acre during the summer season and on the best bottom land 15 to the acre. In northern Kansas it is customary to run only 5 hogs to the acre and then to cut as many crops of hay as would be cut if the hogs were not pastured, the yield, of course, being smaller. From central Kansas down through Oklahoma wheat is extensively used as a winter pasture for hogs, it being available from November to April. Oats and rape are both used more or less extensively for spring pasture for hogs. For the drier periods of summer, when the alfalfa does not make vigorous growth, sorghum is quite generally used for pasture; it carries 25 hogs to the acre. The gains made on this crop are not so rapid as those made on alfalfa. In the section in question it is customary for farmers to run hogs upon the pasture crops mentioned until they attain a weight of about 150 pounds. They are then finished in a feeding period of from thirty to sixty days. It is claimed by experienced farmers that with this system of management from 7 to 10 bushels of corn will produce a 200-pound hog at 8 months of age. The effect of this system of farming is very favorable on the fertility of the soil.

FORAGE FOR BEEF CATTLE AND SHEEP.—The investigations on the production of forage for beef cattle and sheep have been continued during the past year by Mr. J. S. Cotton. Valuable data have been secured and the office is now in a position to formulate complete cropping systems for those farmers living in the corn belt who desire to take up or to continue stock feeding in order to build up their farms or to maintain them at the highest producing capacity. These plans will show the number of a given class of stock that can be handled on such a farm. They will also show the kind of forage that can best be used for a given class of stock, the quantity of such forage necessary, and the proper rotations to be used. This work will be continued, and it is hoped that sufficient data can be secured so that such plans can be worked out for farms in any part of the United States. In addition, a study of forage for horses will be begun during the ensuing year. Mr. D. H. Doane will assist in this work in the future, especially in the study of forage for sheep

SYSTEMS OF MANAGEMENT ON DAIRY FARMS.—During the early part of the past year the services of Prof. George A. Billings, of the New Jersey Agricultural College, were secured for a study of systems of management on dairy farms. In addition to this work Professor Billings, as heretofore stated, has charge of Farm Management District No. 9, consisting of the States of Pennsylvania and New Jersey, in which dairying is one of the leading types of farming. During the past year particular attention has been given to problems connected with the production of high-class milk for the city markets. Much of the certified milk sold in the larger cities is produced on farms owned by wealthy city men, which are conducted at a loss. At the same time, city health authorities have established rules and regulations relating to the production of certified milk based on the practice of these overequipped farms. At best, high-class milk is expensive. How to reduce the cost of production is a very important problem. Professor Billings is studying this question. He finds that much depends on the system of feeding adopted and the corresponding system of cropping to supply the feed. High-class milk can not be produced at a profit on high-priced land where the pasture system prevails. Either soiling crops must be used in summer or silage fed the year round. Particular attention has been given to systems of soiling. Soiling systems have been worked out for a number of farms in his district, and these were put in practice the past summer, with excellent results. Working plans for several dairy farms have also been made. This work will be continued along the same lines during the present year.

CASSAVA AND OTHER GULF COAST CROPS.—The work with forage crops especially adapted to the Gulf Coast States has been continued during the year by Prof. S. M. Tracy, Special Agent. The work in developing early-maturing and abundant seed-producing varieties of cassava is making such satisfactory progress that it is hoped to have a few seeds for distribution next year. Many thousands of seedlings have been grown and annual selection of the best plants made for future propagation. These varieties show great differences in values, both for the manufacture of starch and for feeding, even when the gross yields are similar. Last year, by the cooperation of the Bureau of Chemistry, analyses of 72 varieties were made, the results showing that the starch content of the air-dry roots varied from 60.03 to 70.52 per cent, while the protein content varied from 1.56 to 5.06 per cent. Up to this time the work has been almost wholly in the development of varieties for feeding domestic animals, but the demand for accurate and reliable information in regard to the value of the crop for the manufacture of starch has become so great that arrangements have been made for work along that line also. This new work will be carried on in southern Florida, where the growing season is much longer than farther north and where the canes can remain in the field until wanted for planting.

WEEDS.—During the past year Mr. J. S. Cates, assisted by Mr. H. R. Cox, has continued investigations relating to the control of some of the worst weed pests in the country. Continuing previous work on Johnson grass, tests of the method of eradication previously published were made on many farms in Texas and in a few other Southern States, with eminently satisfactory results. It is now certain that under ordinary field conditions Johnson grass can be easily eradicated and may even be grown as a hay crop in rotation with cotton, corn, and oats and peas without trouble from its weedy tendencies. Work is now being carried on to determine means of exterminating this pest under other than ordinary field conditions.

Much attention has been given to the wild onion, which is so troublesome in dairy pastures and in wheat fields over a wide area in the eastern United States. The agronomic habits of the weed have been fully made out. It has three methods of propagation in addition to reproduction by seeds: (1) By the aerial bulblets, formed in place of flowers on top of the stem; (2) by a large, central, soft-coated bulb, formed at the base of the main stem underground; (3) by one to six small, hard-coated bulbs, formed underground in the axils of the leaf sheaths. The aerial bulblets and the large, soft-coated bulbs germinate in the fall and are easily destroyed by late fall plowing. The hard-coated bulbs germinate in the spring and may be destroyed either by summer tillage or by deep plowing, which buries them so deeply that they will not grow.

Mr. Cox spent part of the year studying the habits of the wild morning glory in California, where it renders land unfit for some types of farming. The pernicious character of this weed is due to its deep-lying rootstock, which the plow can not reach. No practicable method of destroying this weed is known except perfectly clean tillage for one or two seasons.

During the past year it has been found that the methods developed by Mr. Cates for eradicating Johnson grass in the South are also applicable to quack-grass, one of the worst weed pests of the North.

Commercial seed production.—Mr. C. B. Smith has continued the study of farm practice in the production of seeds, giving especial attention to the clovers. The price of clover seed is even higher than last year, due to decreasing yields of seed in the Middle West. This decrease is partly due to the work of insects which destroy the young flowers or the young seeds, but the increasing difficulty of getting a stand of clover is also doubtless partly responsible. Some farmers on the northern edge of the clover region have adopted the practice of clipping the young clover before blossoming time in order to delay seeding. This practice brings the plants into bloom at a time when the insects which destroy so much of the seed crop are not plentiful, thus giving largely increased yields of seed. Clipping, or even pasturing, the young clover to delay harvest time has long been practiced on the Pacific coast, the object there being to bring the haying season on after danger from spring rains is past.

Phenological data.—Mr. H. A. Miller has continued the collection of data on dates of planting and harvesting crops. There are now sufficient data of this kind to be of great service in planning cropping systems in all those sections east of the Rocky Mountains. This work will be continued until satisfactory charts can be constructed for all leading crops for all parts of the country.

FARM ECONOMICS.

The work under the general heading of farm economics covers the following lines of investigation conducted by Mr. W. A. Peck, who is assisted by Messrs. L. W. Ellis and Guy Fitzpatrick.

Farm organization.—Cooperative work has been started on a number of the most productive and successful farms in the north Middle States in accordance with plans previously reported. Detailed records pertaining to the business management of these farms have been collected and are being tabulated. These records include daily labor records showing the exact daily distribution in man and horse hours, feeding rations, and performance records for the different classes of live stock, statements of the farm sales and expenses, and inventories of all equipment and working capital. A study is made of the farm organization as seen in the arrangement of fields, location of buildings, water supply, etc.

In Ohio this detailed study is made in cooperation with the Ohio Agricultural Experiment Station. Some 30 farmers in this State are making detailed reports of all labor, performance records of live stock, financial statements of business transactions, etc. Eleven other farmers cooperating in this work are located in the States of Indiana, Michigan, Wisconsin, Iowa, and Nebraska. Aside from the work in the Northern States, records of the distribution of labor and cost of producing field crops are being collected and tabulated from a number of farms in the Southern States.

Very satisfactory forms for collecting the records have been worked out and the work will now be extended so as to include a larger number of farmers in the several States where it is possible to find well-organized and profitable farms.

FARM ACCOUNTS.—This study pertains to the ordinary farm sales and expenditures—the finances entering into the ordinary business transactions as distinguished from the keeping of farm records, which have to do with labor, feeding, pasturing, and performance records. A study was made of the bookkeeping methods in vogue on the best farms and of bookkeeping systems and treatises offered to the farmer, with a view to working out a more simple and yet efficient system. A bookkeeping system was worked out and put into use on a number of farms a year ago to test its practicability. Now that this test has proved its simplicity and general adaptability, a bulletin on farm bookkeeping will be published as soon as possible.

FARM RECORDS.—Forms for keeping farm records other than financial accounts are being worked out in connection with the cooperative work in the study of farm organization. It is expected that the use of record forms on the farms under cooperation will finally develop a system for keeping general farm records which will be practical for those who desire to get at cost accounting beyond the mere keeping of financial accounts. At present very satisfactory forms for keeping detailed labor records have been worked out.

FARM EQUIPMENT.—This subject, in charge of Mr. L. W. Ellis, includes an economic study of farm machinery, buildings, fences, etc. Data for determining the efficiency of machinery, the utility of farm buildings, fences, etc., are being secured so as to properly equip farms of different types and sizes. The annual cost and depreciation of machinery, buildings, and fences are being determined as factors in the cost of production and relative profitableness of the different farm enterprises. Complete farm inventories have been made on more than one hundred of the most successful farms in the north Middle States as a basis for studying farm equipment in actual practice. Manufacturers of machinery and implement dealers, as valuable sources of information, have been reached by correspondence and visits. Equipment catalogues have been collected and filed for ready reference. Owing to the increasing demand for information regarding the use of power for plowing, etc., special attention is being given to this problem.

FEEDING SYSTEMS.—This is an economic study of feeding systems as practiced by successful live-stock farmers, made with a view to securing data which can be used in planning cropping systems. The work was started this spring in the State of Indiana. Twenty-six live-stock farmers with facilities for weighing live stock, etc., were selected to act as cooperators. A special agent was employed to visit each of these cooperators regularly every month to weigh the feeds being fed as daily rations, to assist in the weighing of the live stock, and to collect and keep the records of such feeding and weights. Changes made in the daily rations during the absence of the special agent are noted by the farmer, so that records are complete for the whole period. The records are collected and monthly tabulations to show unit values are made in duplicate, one copy of which is given to the farmer.

RANGE MANAGEMENT AND CACTUS INVESTIGATIONS.

The work of this section of farm management investigations is conducted by Dr. David Griffiths, assisted by various representatives of the office whose work lies principally in the range States.

RANGE MANAGEMENT.—During the year 1907 the usual routine work has been accomplished upon the large range tract in the Santa Rita Mountains. Doctor Griffiths made two visits of several days each to the region—the first in the spring, April 9 to 13, and the second in the fall, September 24 to 28. These seasons were propitious, for vegetation was then in its prime. At both of these times the ranchers surrounding the large inclosure were visited and consulted with reference to cooperative work. In the spring two of the ranchers had begun fencing operations on the strength of our recommendation, the Forest Service having granted them permission to do so. These people will keep a careful record of their grazing operations, number and date of holding cattle in the pastures, nature of pastures at different seasons, comparisons of pasture now and later after several years' protection, and the change which takes place in the vegetation under protection. Records of pastures are slow to obtain, of course, and results are to be considered in terms of averages of several years. It is believed that these records will be valuable in time as an indication of what these people will be able to accomplish in this badly overstocked country. They will be all the more interesting and important from the fact that the ranchers' individual ideas will be permanently represented in the management of the pastures. These, together with the results of complete rest as exhibited in the large inclosure, will be important and interesting.

The past year has been on the whole a good range year, but not entirely without its drawbacks. All of the winter seeds germinated well in the fall and there was sufficient moisture during the winter to keep them in good condition; but vegetation which started did not grow much during the winter on account of severe cold. In the spring the moisture failed, the small seedling plants, instead of growing for a time, went to seed almost immediately on account of the dry weather, and consequently produced comparatively little feed. So sudden was the transition from cold, wet weather to warm, dry weather that many plants dried up without producing any seed at all.

The jack rabbit is playing an important part now in the destruction of native vegetation in the big pasture. Food has been so short outside that these animals have congregated in large numbers in the inclosure, and their presence is having a telling effect upon the vegetation. The growth of grass during the summer season was very good upon the upper third of the field, but it has been better in the lower part several times since the work began. A conspicuous feature of the upper part of the field is the much cleaner growth of grasses that is occurring as the years go by. The native grasses of little value are becoming less conspicuous than they were when the area was fenced, and the more valuable are producing thicker stands.

The studies in the practice of ranchers in the range States are being continued along the same lines as heretofore. The behavior of protected areas in Arizona is being studied year by year, and this study is yielding some very interesting results. In this region the denudation has been excessive. A careful comparison is being made between moderately grazed lands and those having complete protection. Reseeding is yielding negative results, but under all systems of protection there seems to be no doubt that the perennial grasses are assuming ascendency over the annual weedy ones. This takes place very slowly under arid conditions, but that it can be accomplished economically by proper management is fully proved.

The investigations in the Wenache Mountains conducted by Mr. J. S. Cotton have been closed and the result published in Bulletin 127 of the Bureau of Plant Industry, entitled "The Improvement of Mountain Meadows," which shows very clearly what improvements can be accomplished in the mountain meadows of the Northwest. There has also been issued during the past year a bulletin by Doctor Griffiths, entitled "The Reseeding of Depleted Range and Native Pastures," in which the results of several years' work on this subject are given.

In the northwestern plains region many data showing the amount of land and stock necessary in order to give a man a good living have been obtained. The study of the different methods of handling stock has been continued, with the result that it is now possible to advise a beginner as to the best methods of procedure. The office is also in a position to give many of the old stockmen considerable expert advice on the best methods of handling their ranges.

CACTUS INVESTIGATIONS.—The work of converting the native cactus of western Texas into a farm crop conducted by Doctor Griffiths has advanced very satisfactorily during the year. The use, value, and productivity of the spiny native prickly pear of southern Texas having been demonstrated last year at San Antonio, the main feature of this year's work has been, and will be for a year or two to come, to demonstrate the place and value of the spineless varieties. The work on the spiny varieties under different conditions and with different treatments is being continued, but the main effort is being placed upon a demonstration of the real place of the spineless varieties in the agriculture of the warmer sections of the country. Arrangements have been made for planting eight areas of considerable size in the warmer sections from central California to Florida. It has been impossible to make these tests earlier because the stock had to be grown from two or three cuttings of each variety. This stock has been multiplied as rapidly as possible, and last year more than an acre was set out upon propagating grounds at Chico, Cal., for use in these tests.

The extended use and decided value of the spiny native "pears" of Texas are very well illustrated by the experience of a single individual who marketed during the past winter 1,650 beeves fed on prickly pear and cotton-seed meal at one-half the cost of the standard ration.

FARMERS' COOPERATIVE DEMONSTRATION WORK.

During the past fiscal year the farmers' cooperative demonstration work, under the direction of Dr. S. A. Knapp, Special Agent, has been conducted throughout a large portion of the Southern States. Owing to the northward extension of the work the headquarters have been transferred from Lake Charles, La., to Washington, D. C.

The following is a brief description of the plan and organization of this work:

TERRITORY COVERED.—Under Congressional appropriation the work has been inaugurated throughout northern and eastern Texas, through the southern part of Oklahoma, southern Arkansas, northern and western Louisiana, and in one district in southwestern Mississippi. These are districts which are either wholly or in part infested by the Mexican cotton boll weevil. Through the General Education Board and others cooperating with the Bureau of Plant Industry, the demonstration work has been extended throughout Mississippi and parts of Alabama, Georgia, South Carolina, North Carolina, and Virginia.

AGENTS.—A corps of field agents, classified according to territory as State, district, and local agents, is employed. The local agents are appointed mainly on the advice of local committees of business men and farmers conversant with the territory to be worked. District and State agents are required to have a knowledge of scientific agriculture, but must also have had a number of years' practical experience in farming. A salient feature of the work is that all agents are residents of the States in which their work is located and know the people and the conditions. At the present time 65 agents and collaborators are employed under congressional appropriation and 92 under cooperation with the General Education Board and others. The 65 strictly Government agents and collaborators are distributed as follows: Texas, 28; Oklahoma, 8; Louisiana, 13; Arkansas, 12; and Mississippi, 4. The other 92 employees are assigned to the following States: Mississippi, 19; Alabama, 17; Georgia, 7; South Carolina, 15; North Carolina, 13; Virginia, 17; and one each in Texas, Oklahoma, Louisiana, and Arkansas.

OBJECT AND PLAN OF THE WORK.—The primary object of this work is to induce the farmers by demonstrations in that section where the Mexican boll weevil is present to follow a system by which a crop of cotton can be successfully and profitably grown and, as a corollary to this proposition, to show that the yield of cotton and other staple crops can be greatly increased in all parts of the United States, thus materially increasing the net earnings of the average farmer. The crops at present under demonstration are limited to the standard farm crops in the localities where agents are employed. The same plans used in former years have been carried out. It was realized that if the masses of the people were to be brought to a higher standard of agriculture, it must be mainly done by inducing the farmer himself to conduct the work instead of the work being conducted and the demonstration carried on for him by the Government, and that as far as possible it would be best for the farmers to support the work which would be conducted for their benefit. These reasons are based on the broad experience which is so well established in business lines and missionary fields, showing that the important thing necessary to secure the sympathy and cooperation of the people is to have the people themselves do the work and contribute to its support. In accordance with this proposition, the Farmers' Cooperative Demonstration Work is carried on through demonstrations by the farmers without any compensation and with no guarantee on the part of the Government except that they shall be thoroughly instructed by an agent of the Department.

Classes of farms established.—Two classes of farms have been established—the demonstration farm, which is visited by an agent once a month to see that instructions are being carried out, and the cooperating farm, which is not visited by an agent except upon special request, but which receives instructions by mail. When the agent is making his visit to the demonstration farms, he notifies the cooperators in that vicinity that he will meet them on the farm of the demonstrator at a certain time. These small field meetings, composed of from five to thirty farmers of the neighborhood meeting the agent on the demonstration plat and holding an informal school of agriculture, have proved to be of great benefit to the farmers of the different communities.

Instructions.—General printed instructions have been prepared in language easily understood by the average farmer or tenant and distributed to all demonstrators and cooperators. These instructions cover the entire working of the crop from the preparation of the land to the harvest and the selection of seed for another year. In addition to Farmers' Bulletin 319, entitled "Demonstration Work in Cooperation with Southern Farmers," there have been issued eight circulars, of which about 400,000 copies have been distributed.

Extension and division of the work.—Through the General Education Board of New York, cooperating with the Bureau of Plant Industry, the demonstration work has been carried on from Mississippi eastward in Alabama and Virginia, entering the States of Georgia, North Carolina, and South Carolina for the first time during the past fiscal year. The men employed in this work are under the direct supervision of Doctor Knapp, but the entire expenses of the work are defrayed by the General Education Board. While all classes of farmers are aided in each locality, there is special work done among independent colored farmers at two points in Alabama, one point in Mississippi, and four points in Virginia. At these points colored agents are employed, those in Virginia being in cooperation with Hampton Institute and the others with Tuskegee Institute, in Alabama, a portion of their salaries being paid from what is known as the John F. Slater fund. This work promises excellent results.

Cooperation.—At the close of the past fiscal year there were in operation about 10,000 demonstration farms, and 22,000 cooperators were also engaged in the work. The demonstrators receive instructions direct from the agent, on their own farms, and the majority of the cooperators are instructed at the field meetings. In addition to these field meetings the agents in this work hold a large number of local meetings throughout the territory. Special attention is also paid to cooperating with the State authorities, experiment stations, agricultural colleges, boards of trade, and other agricultural agencies. Great interest has been aroused in the work, and in many cases where the Congressional appropriation would not cover the expenses of the agents they have been supported from other sources.

Seed.—As far as possible the endeavor has been made to induce cooperators and demonstrators to secure improved seed at their own expense. If the Department attempted to distribute free seed to all it would take more funds than the total appropriation. During the past fiscal year there was furnished by this Bureau to the demonstration farms selected seed costing about $2,500, while through the direct influence of agents in this work, demonstrators, cooperators, merchants, business organizations, etc., there was purchased approximately $140,000 worth.

Plans for future work.—During the ensuing fiscal year the work is to be extended through Oklahoma, where the cotton boll weevil has been doing considerable damage. Work will be continued in Texas, Louisiana, Arkansas, Mississippi, and Alabama, and additional work undertaken in Georgia, South Carolina, North Carolina, and Virginia. The demonstration work will be started during the fall of 1908 in northern Florida. The work in cooperation with county superintendents and schools will be greatly enlarged during the coming year.

WORK CONNECTED WITH THE PURCHASE AND DISTRIBUTION OF SEEDS.

The various lines of work of seed and plant introduction and distribution have been carried on as in previous years. These include foreign seed and plant introduction, forage crop investigations, and the seed distribution. The following is a brief summary of the work of the past fiscal year:

FOREIGN SEED AND PLANT INTRODUCTION.

As heretofore, the work of plant introduction has been under the charge of Mr. David Fairchild, Agricultural Explorer, assisted by Messrs. Walter Fischer and R. A. Young. The agricultural explorations of the year have been conducted by Messrs. Frank N. Meyer and William D. Hills, special barley investigations have been carried on by Dr. Albert Mann, Expert, and the field work of growing our introduced matting plants has been carried on by Mr. F. W. Clarke. The botanical determination of newly introduced plants has been made by Mr. H. C. Skeels, under the supervision of Mr. W. F. Wight, Botanist in Charge of the Economic Collections.

Agricultural explorations.—Mr. Meyer concluded his Chinese explorations this year and brought back with him a large collection of living plants, which are now at our various plant-introduction gardens. He has been three years continuously in northern Korea, eastern Siberia, the whole of the central provinces of China, and all of Manchuria; he has walked several thousand miles and covered great distances in native carts and wheelbarrows in his search for new plants. He has brought back not only a rare collection of possibly valuable plants and botanical specimens, but a fund of information and a collection of 400 photographs illustrative of the dry-land farming practices, the horticultural methods, the market-gardening operations, and the forestry of the Empire, which will be of great value in presenting to the American farmer an accurate picture from an expert's standpoint of the agriculture of this immense country, of which the average American knows so little, and which is sure in the future to interest him much more than it does now.

In his explorations this year Mr. Meyer made a visit to the bamboo regions of Tangsi, Hangchow, Mokansan, and Ningpo, where the successful cultivation of the many varieties of bamboos affords a livelihood to thousands of Chinese, and where he secured a shipment of over 300 plants of 29 different species of this important group. In Mr. Meyer's opinion, some of these varieties of bamboos will supply the fruit growers of the mild-wintered regions of the United States with a long-wished-for material for the manufacture of fruit boxes, poles for supporting heavily laden fruit trees, furniture, and for various other purposes.

Mr. Meyer has made two trips to the bleak, arid mountains of Wutai, where he found two new spruces, a larch, a wild gooseberry, a wild currant, a new pine, a rose, and a willow which will be of interest to those who live in the trying, arid climate of the Northwest. He made an expedition to the imperial hunting park of Jehol, where he found some interesting wild pears and several new varieties of cultivated pears, among which is an apple-shaped variety of agreeable sour flavor, used locally for preserving. He also made an expedition to the Pang Mountains, where he found whole hillsides covered with wild apricots and where wild walnuts and wild chestnuts abound, some of which may prove unusually hardy in our climate. He made an extensive exploration of Shantung, the great fruit province of the Empire, and found there extensive orchards of various, even seedless, varieties of the Chinese date, which may possibly create a new fruit industry for our arid Southwest. He found the famous Fei-tcheng peach, specimens of which weigh over a pound and are kept by the Chinese until February. This may be a new strain of what is known in America as the Chinese Cling, and especially adapted, as Mr. Meyer predicts, for cultivation in the irrigated regions of Utah. Arrangements will be made to secure this in quantity.

The foregoing are merely a few of the valuable things secured by Mr. Meyer. His success in this pioneer field of exploration will make it possible to comply the coming year with the urgent request of the fruit breeders of the Northwest to send into the dry, cold regions of central Asia after the wild species and varieties related to our common fruits, which they require for the origination of entirely new and more drought and cold resistant sorts of fruit trees with which the orchards of the Northwest can be supplied. He is expected to leave the coming autumn for this exploration of the oases of western China.

New plant introductions.—The organization for securing from foreign countries by correspondence the seeds and plants that are likely to improve our existing crops or lead to the cultivation of new ones has been improved and perfected, until now an average of nine selected things is received every day and distributed among the farmer experimenters and experiment stations of the country. These vary much in character. The plan is, by providing plant breeders and experimenters with the necessary material, to stimulate the creation of a greater diversity of crops throughout the country. Space forbids more than the barest mention of a few of the new things which this office has brought in during the last year and which are now being experimented with by enthusiastic plant growers in different parts of the country or by the various experts of the Bureau of Plant Industry.

Among the valuable new seeds and plants secured in this way are a collection of Bagdad varieties of the date palm; the Natsu Mikan, or summer bitter orange of Japan, a delicious fruit to follow the pomelo;

a remarkable collection of wild and cultivated potatoes from the archipelago of Chiloe and the neighboring mainland of Chile, the home of the potato; a shipment of wet-land taros, root crops for the South from Java, and another from Barbados; new grasses from Argentina; the much-written-of White Alfonso mango from Calcutta, which has produced 2½-pound fruits; a valuable dry-land olive, which is interesting as a possible stock in Arizona for the common olive; and the "grano marzuolo," a special variety of wheat, the straw of which is used for plaiting in Italy.

CORK-OAK INDUSTRY.—An investigation has shown the presence in many places through the South of large and apparently vigorous cork-oak trees, most of which are the result of early distributions of seed by this Department. The fact has thus been established that the trees will grow in this country, and in order to secure material for the early establishment of small forests of this plant several barrels of the acorns have been imported from Spain, and the seedlings are now being prepared for distribution. One of the large linoleum factories in the country is interesting the right kind of landowners—those who can wait for results—to plant the young trees on their estates.

BAMBOO INTRODUCTIONS.—The possibility of cultivating in the Southern States the hardy bamboos of the Orient has for some time attracted the attention of this office, and during the last year a special agent has been sent to Japan for the purpose of getting together a large shipment of the best timber bamboos for introduction. He has now in his nursery rows over 3,500 large plants, which will be dug this fall and brought over in a Government transport, and after they have been given a chance to recuperate, they will be set out in acre or larger plantings in cheap lands along the Gulf, where the common and worthless American bamboo, or "cane," grows luxuriantly. The many uses to which these remarkable plants are put will only be apparent when Americans have them in the green state, so that they can work them. Unlike the ordinary timbers of the country, they are handled mainly while in a green state. It is expected that they will be useful for temporary irrigating pipes, barrel hoops, fruit crates, light fruit ladders, cheap shingles for temporary structures, light fence posts and fencings, flower stakes, vine supports, hothouse shades and awnings, and as a possible source of paper. Samples of bamboo cloth from China have been received which indicate that there is even a possibility that the tough fibers of the plant can be used for the manufacture of special cloths for the making of summer clothing.

The Bureau is fortunate in having in this work of bamboo introduction the hearty cooperation of Mr. William E. Tevis, of Bakersfield, Cal., who has on his place the largest groves of the oriental bamboo in America and who is a firm believer in their future value to the country. The rapidity of growth of some of his plants is remarkable. From a single plant in a pot, he has now, eight years afterwards, a crop of 200 shoots ranging in size from 45 to 65 feet in height and from 3 to 5½ inches in diameter.

MANGOSTEEN INTRODUCTION.—The successful grafting of the mangosteen, the so-called "queen of tropical fruits," by our expert propagator is an accomplishment which marks a decided advance in the attempt to introduce this remarkable fruit into the western Tropics. It can hardly be questioned further that the chief difficulty in the acclimatization of this fruit tree in regions remote from its home in Malaysia has been the weak root system which the trees possess, and the discovery that it can be grafted on stock which is less peculiar in its soil demands will open up new possibilities in its culture and make the attempts which the Bureau is fostering to grow it in the Panama Canal Zone, Porto Rico, and Hawaii much more likely to succeed. The introduction from different parts of the oriental Tropics of the numerous species that may serve as stocks and the investigation of some of the other edible species is being carried on.

JAPANESE PAPER PLANT.—For several years the Office of Foreign Seed and Plant Introduction has been sending out for trial thousands of young seedlings of the Japanese paper plant, from which a remarkable range of the finest, silkiest papers in the world are made. This wide distribution was for the purpose of finding out definitely where the plant would grow satisfactorily. As a result of this trial it has been proved that in the region of Atlanta and Augusta, Ga., the plant grows quite as luxuriantly as it does in Japan, and next season a small trial area of the plant will be set out on land where last year several hundred seedlings grew well, in order to see how cheaply this remarkable long-fiber paper stock for book papers, vellums, and soft "Japanese" papers can be produced. It has been a matter of surprise to find how easily the bark can be removed from the young plants and how feasible it would be to harvest the plants by machinery.

MATTING-PLANT INTRODUCTION.—The first piece of American-grown as well as American-woven floor matting has been produced this year as a result of the introduction a year ago of the Chinese sedge plants. The plants for this first yard or so of matting were grown simultaneously in South Carolina and in Hawaii, and while our experimenters did not discover the first time the exact stage for the cutting of the straw, they came very close to it, and are confident that the next time they will have a straw that will equal in quality the imported article. Areas of the plant in South Carolina, Louisiana, and Texas are now under the supervision of the Department, and notwithstanding the fact that there appeared in the Texas plantation a very serious fungous disease related to those destructive diseases of the grape and potato known as mildew and rot, respectively, the ability to produce the straw has, it is believed, been demonstrated and a method worked out for the control of this disease, which is a new one in the Orient and was unavoidably imported with the roots.

Much remains to be done in the development of labor-saving devices for the splitting and curing of the matting straw, but already substantial progress has been made in this direction and the prospect of the establishment of this industry as a new and remunerative one in the South seems unusually good. As our floor mattings cost us every year over $5,000,000, the establishment of a home industry which will at least get a part of this sum is worthy of serious consideration.

The Egyptian samar, a plant used in Egypt in the reclamation of alkali lands and employed by the fellahs for the weaving of mats for their mosques, has been successfully grown on a small scale in the Southwest, and from the coarse stems our experts have split straws which the manufacturers have woven into matting that they pronounce to be of very good quality. In color and texture these samar split straws excel the oriental sedge, and if the drawback of brittleness can be overcome by earlier cutting and quicker drying, we may have in this Egyptian plant a valuable introduction for Arizona. The Office of Foreign Seed and Plant Introduction is searching the world for other kinds of matting plants adaptable to cultivation on cheap soils in the South, and has imported some very promising material from Madagascar and India.

Reed-lath matting.—The price of laths has increased 25 per cent in the last two years. Special looms for the weaving of floor matting have been invented in this country. In Sweden, Denmark, and Germany, the common reed, which is also abundant in America, is used on a large scale and preferred to laths, being woven into a matting for the purpose. A preliminary survey of the situation has shown that it will be possible to utilize these reeds (Phragmites), including possibly the switch canes and the pipe canes (Arundinaria) which grow along our waterways in immense quantities, in the manufacture in suitable looms similar to those used for floor matting of a reed-lath matting which has certain advantages over the ordinary laths and which can be put on the wall, it is believed, cheaper than laths. The trials made show that the material, though not quite so strong as laths, is strong enough for partition work and has the advantage of producing a better "key" of mortar, of being a better deadener of sound, of being much easier to put on, and of not absorbing water, as in the case of laths, therefore not cracking the plaster as it dries. This investigation points to a perpetual annual source of material for laths and at the same time the utilization of what are now waste lands along our waterways. This work has been the outgrowth of a suggestion of Mr. Ivar Tidestrom, of this Department, who is a native of Sweden, where these reeds are largely used.

Mangos for Florida, Hawaii, and Porto Rico.—An unusual number of our imported East Indian mangos have fruited this season and have shown the growers of this coming tropical and subtropical fruit that they must consider seriously the question of what variety to plant. The fact that the Mulgoba variety is a shy bearer is being plainly indicated, and the more progressive planters are turning their attention to such forms as the Bombay Yellow, the Sundersha, and the Alfonse, which have better reputations in this respect. As a result of the stimulus of the Department of Agriculture, mango groves of considerable size are being planted in Hawaii, Porto Rico, the Isle of Pines, and southern Florida, and although mango growing is not yet on a sound financial paying basis, it is reaching that stage as rapidly as such an industry can be expected to develop. The Department has in hand the securing of better bearers and varieties which will fruit earlier or later than those now being grown, in order that the fruits can be put on the northern markets while the customers who buy such things are still in town, before they go away for the summer or after they return. A distinct advance in the sending of young mango trees has been made by the office, and successful mail shipments of small trees as far as Hawaii are now being made.

MISSISSIPPI VALLEY PLANT INTRODUCTION GARDEN.—In cooperation with the Iowa State Agricultural College and Experiment Station at Ames, and under the direction of its horticulturist, Mr. S. A. Beach, the office has started a plant introduction garden for the purpose of propagating there as rapidly as possible the hardy fruit and other trees which are being secured especially for the fruit breeders of the upper Mississippi Valley. A good propagator has been employed and already the necessary stocks have been gotten together for propagation, including many of Mr. Meyer's introductions from northern China. The plants grown there will be sent out upon request to the office, just as they are now sent from the garden at Chico, Cal., and it is the aim of the garden to disseminate the material in such a way that it will get into the hands of the plant breeders as quickly as possible throughout this great northwestern region, in which hardier fruits are so much needed. As mentioned elsewhere, a special effort will be made the coming year to get the wild and cultivated fruits from the great Asian plateau, and as far as possible to place in the hands of the breeders the hardiest forms in the world, with which they can work in the origination of strictly hardy fruits which can be grown through the Northwest.

SPECIAL BARLEY INVESTIGATIONS.—This work has been carried on along three lines:

(1) Dr. Albert Mann has continued his laboratory investigations of the internal mechanism of the barley grain. These studies are definitely locating the vital energies of the grain in such a way that the knowledge can be turned to practical use in breeding superior varieties. The important bearing which the shape of the scutellum of the kernel has been shown to have upon the malting qualities of barley appears not to have been recognized prior to Doctor Mann's researches. It seems quite probable that the form of this organ will have to be given great weight hereafter in the breeding and selection of high-grade barleys. The discoveries made have been recently submitted in a general way to some of the leading barley specialists of Europe and have met with strong commendation.

(2) In connection with Doctor Mann's laboratory researches field investigations are being carried on by Mr. D. W. Frear. Some 80 experimental plats are being cultivated near St. Paul, Minn., and about 60 others in the Northwest and on the Pacific coast. Problems in the relative yield of new varieties, their adaptation to differences in soil and climate, and work in the breeding of better races are thus being carried out. Thirty acres of land at Morris, Minn., and 9 acres at Zumbra Heights, Minn., are being devoted to raising crops of the two best Swedish pedigree stocks for a practical malting test.

(3) Doctor Mann has been sent to investigate the best barley districts of Europe and to collect information upon the most approved cultural methods. He has studied the latest processes in breeding and selection and has discussed with foreign barley experts such questions as bear upon this line of work. He was instructed to give particular attention to the experiment station at Svalöf, Sweden, made famous by its remarkable development of pedigree barleys, and to investigate the Svalöf system of collecting, testing, and classifying new varieties. The cultivation of this grain has been brought to so high a degree of perfection in certain districts of Europe that a

thorough study of these fields is of special value, and the need for improvement in our own barley crops makes such information most important.

Economic collections.—While not falling directly under seed and plant introduction, the economic collections, in charge of Mr. W. F. Wight, have been brought into closer touch with that work during the past fiscal year. The work is conducted largely in cooperation with the other offices of the Bureau, and material is collected of the various species and horticultural varieties of those species or plants being investigated or tested by the Office of Foreign Seed and Plant Introduction or other branches of the Bureau. This material serves as a part of the permanent records of the offices concerned, and about 2,000 specimens of these plants have been collected during the past year and the nomenclature corrected when necessary. Many of the seeds secured in foreign countries are received under wrong names, and since February 1, 1908, a sample of each introduction has been submitted for identification. During the five months this work has been in progress about 1,200 samples have been examined, one-eighth of which were found to be either incorrectly named or of unknown identity.

During a part of the year work has been in progress on the compilation of an index for the purpose of making immediately available to the Office of Foreign Seed and Plant Introduction information concerning the use, detailed distribution, and economic character of plants desirable for introduction into the United States.

FORAGE CROP INVESTIGATIONS.

The work with forage crops, of which Prof. C. V. Piper, Agrostologist, is in charge, has been continued along the same lines as during the prevous year. The principal aims of the work are to bring about the greater use of the most valuable forage legumes and grasses wherever they can be profitably utilized; to test all new forage plants thoroughly and to introduce such as are promising; and to develop, by breeding, improved strains of the most important grasses, sorghum, and alfalfa and other legumes. The following is a digest of the most important lines of work conducted during the past fiscal year.

ALFALFA.

The work with alfalfa has been conducted by Mr. J. M. Westgate Assistant Agrostologist, assisted by Mr. Nickolas Schmitz. This year, as in the past, much attention has been given to the agricultural extension of alfalfa in sections where it is not now grown, but where preliminary experiments have indicated that success with this crop is reasonably certain under proper management. During the past year cooperative experiments have been conducted with over 900 farmers. In several States the work has been conducted in cooperation with the agricultural experiment stations. By a somewhat new departure in the extension of alfalfa, the work is now confined principally to sections of a State at one time, rather than to an entire State. This is done chiefly by Congressional districts. The cooperators selected as a whole have spared neither time nor money to make this work a success, and the results obtained are very gratifying. In many instances one successful field in a community has led many neighboring farmers to establish alfalfa on their own places.

In the past, great difficulty has been experienced in securing proper inoculation for alfalfa in unfavorable soils and seasons in the East. This year the difficulty has been partly overcome by using soil from old alfalfa fields or from patches of sweet clover or bur clover for inoculation. In practically every case where good soil free from weeds and disease could be secured and properly applied, perfectly satisfactory results have been obtained this season. While experiments show that some soils, such as those derived from limestone, are far better adapted to alfalfa than others, paying crops can be grown on any deep, well-drained soil properly prepared (limed if necessary) and in a good state of fertility. It has been found that in the East in many cases the use of fertilizers on alfalfa is profitable. Extensive tests are now under way to determine the most economical methods of fertilizing. Weeds very often become troublesome in eastern alfalfa, with the result that the life of the field is shortened. Cultivation experiments are now under way to determine the best methods of keeping weeds under control.

HARDY ALFALFA.—Last year attention was called to the probable relationship between commercial sand lucern and Grimm alfalfa. This subject has been carefully investigated during the past season. These alfalfas agree in being extremely hardy and in showing a remarkable variation in the color of the flowers on different plants and sometimes on the same plant. From 10 to 70 per cent of the flowers are some other color than the violet of ordinary alfalfa. The other colors include occasional yellow, cream, blue, bluish green, and greenish black. The same characteristics of hardiness and of variation in the flower color are also found in much of the Canadian alfalfa grown in Ontario. The explanation usually accepted by European botanists of this flower color variation is that it is the result of crossing with the yellow-flowered species. It is very probable that the additional hardiness is also the result of this crossing. These crosses have often been considered by botanists as distinct species or varieties and many names have been proposed for the varying forms, such as *Medicago varia*, *M. media*, *M. intermedia*, *M. sativa* var. *versicolor*, etc. While different fields of the same strain may vary considerably in the percentage of varicolored flowers, no corresponding variation in hardiness has been noted.

European sand lucern unfortunately often contains much weed seed and is therefore objectionable. On this account the seed production of these hardy alfalfas is being fostered, especially in northern Montana, where the severity of the winters will largely preclude any accidental mixture with nonhardy varieties.

In addition to the hardiness of this variety of alfalfa, it is also proving to be remarkably drought resistant and is being found superior to all others in numerous comparative trials. The remarkable variability shown by this alfalfa has made it a most fruitful source for selection, both for increased seed yield and for hay production.

The yellow-flowered Siberian alfalfas secured by Professor Hansen have been grown at several stations and a small quantity of seed secured. It is now planned to test them as extensively as possible where the climate is both very dry and very cold, especially in the western part of the Dakotas and eastern Montana. Professor Hansen has again been sent to Siberia to secure additional supplies of seed.

Alfalfa for seed.—The investigations to determine the best methods of producing alfalfa seed have been continued and the practices in the irrigated sections have been correlated.

The endeavor is being made to secure heavy seed-producing strains, and several hundred selections have been made to this end. The results indicate conclusively that increased seed yields may be obtained by selection, the test rows in many instances repeating the heavy seed yield of the parent.

The Arabian alfalfa still continues to give most striking results in California and the Southwest, and hardy selections of this variety are being vegetatively propagated to make its extension northward possible. The difficulty of securing this seed from Arabia is so great that arrangements have been made to grow it in quantity in southern California.

GRASSES.

In the work with grasses, under the direction of Mr. R. A. Oakley, Assistant Agrostologist, assisted by Mr. H. N. Vinall, some interesting facts have been obtained from the testing of mixtures of grasses for pasture and meadow purposes. The results of tests at the Arlington Experimental Farm indicate definitely the superiority of mixtures of grasses over a single grass, especially for pasture. Under conditions unfavorable to the best growth of Kentucky bluegrass, mixtures of several valuable pasture grasses have proved of decided advantage. There is a great demand for satisfactory grass mixtures, and numerous tests are being conducted in cooperation with farmers.

Improved varieties of timothy, originated by breeding and selection, are being tested thoroughly in cooperation with farmers in four of the principal timothy-growing States. It is believed that, aside from securing varieties giving greater yield than the ordinary timothy, it will be possible to establish strains adapted to special conditions. During the past season the damage to the timothy hay crop from rust has been considerable, and it has greatly emphasized the necessity of breeding improved strains which will be resistant to rust. This point is being given special attention, and in the future no improved varieties will be put out for general testing unless they have first shown definitely their rust resistance. Several new selections have shown marked resistance, and it is believed that it will be possible to put into general cultivation varieties possessing the advantages just mentioned and at the same time being practically rustproof. As is the case with many other grasses, timothy cross-fertilizes readily, and owing to this it is difficult to secure pure-bred seed. Efforts are being made to overcome this difficulty.

Improved strains of orchard grass are also being developed and enough seed has been secured this season to conduct careful comparative tests. The prejudice against this grass is due largely to its coarseness and lack of ability to form a satisfactory sod. Undoubtedly much can be done in the way of increasing the popularity of orchard grass by establishing strains possessing superior qualities in respect to these points.

Para grass has been tested so thoroughly in the extreme South and Gulf coast region that it has now become quite well established. This grass has proved highly satisfactory both for hay and pasture and can be recommended in sections of the South under a rainfall of 40 or more inches and where the temperature does not fall below 18° F. It has also been tested in parts of California on overflowed lands. It can be easily killed by shallow plowing late in the fall, except in the extreme southern part of Florida.

Canada bluegrass has been looked upon in this country with general disfavor, which is largely due to the fact that it has been used extensively as an adulterant of Kentucky bluegrass and when used for lawn purposes is very undesirable. Recent investigations have indicated that there are conditions under which this grass can be grown to advantage, and extensive tests to determine these points are at present being conducted. On poor clay soils unsuited to Kentucky bluegrass Canada bluegrass makes very good grazing, and in certain sections it is a valuable pasture grass for finishing cattle.

SORGHUMS.

The work of breeding pure and improved strains of the best forage sorghums is being continued. Marked improvement has been secured with blackhull kafir and with dwarf milo, and quantities of the seed have been grown for general distribution. Among the new sorghums secured three deserve particular mention. Pink kafir, recently secured from Natal, is so promising that a large amount of seed has been grown to permit of its general introduction. Thus far it has given a greater seed yield than blackhull kafir, though otherwise there is little to choose between them. Honey sorghum, of unknown origin, but grown very locally in Texas for some years past, is the sweetest sorghum yet known. Arrangements have been made to secure quantities of this seed for general distribution. "Feterita" is a remarkable sorghum said to be much grown in the Sudan, but not obtained by the Department until 1907. It has strictly erect heads with very large dull white seeds that do not shatter until long overripe. It is of good value as forage and will probably prove of very high value as grain. It is even earlier than dwarf milo and this, together with its handsome white seeds, will undoubtedly lead to its extensive cultivation. From small plats the yields have been as large as of milo.

The large number of sorghum varieties recently disclosed make it very desirable to determine the best for each region and to restrict the culture as much as possible to that one variety, as these plants are very prone to cross and thus deteriorate. This matter is of particular importance where the crop is grown especially for the grain.

SOY BEANS.

The soy bean is rapidly growing in popularity, especially in the South, both as a hay and a seed crop. A great number of lots of soy beans have been obtained from foreign sources during the past two years, and this has revealed a wealth of varieties hitherto unsuspected. Over one hundred and fifty distinct varieties have been compared, and the results show that among the new varieties there are several of very high value. Several of these have outyielded both in hay and seed production the Mammoth, which is the variety now commonly grown.

The rice-land varieties of soy beans used so extensively in China have proved exceedingly well adapted to the Louisiana and Texas rice lands. They promise to meet fully the need of a satisfactory legume to use in rotation on these lands.

COWPEAS.

Conditions during the past have served to emphasize further the importance of getting the seed of cowpeas on the market at lower prices than have prevailed in the past. A perfectly satisfactory thrasher for cowpeas has recently been invented and is now on the market. As a result of advice and suggestions from this office, a large number of farmers have arranged to handle their cowpea crop almost exclusively by machinery. A new variety, the Brabham, was first grown by the Department on a small scale last year and proved so promising that it is being tested in many sections of the South this season. Indications are that it will prove to be a very valuable variety, since it makes a large, erect growth and produces an abundance of seed.

MOTH BEAN.

The moth bean (*Phaseolus aconitifolius*) is a fine-stemmed, spreading, leafy, annual legume recently introduced from India. It has been tested quite thoroughly in northwestern Texas and Oklahoma, where it has frequently yielded 3 tons of cured hay to the acre when planted in rows 3 feet apart. The hay produced is not coarse and is of excellent quality. When planted in rows 3 feet apart, the moth bean covers the entire surface of the ground and prevents the evaporation of soil moisture. It readily becomes exceedingly well inoculated and is valuable for green manuring. This plant promises to be a very valuable crop for northern Texas, Oklahoma, and southern Kansas.

VELVET BEANS.

Recent investigations have disclosed the fact that in southeastern Asia there are many varieties closely allied to the velvet bean. Several of these have been obtained and are being tested in comparison with the Florida velvet bean. One of these varieties, *Mucuna lyoni*, from the Philippines, promises to be of great value in the Gulf coast region, where it has been cultivated for the past two years. In habit of growth it is very similar to the ordinary velvet bean, but it is even more luxuriant. It also produces seed more abundantly and matures somewhat earlier, both of which are decided advantages.

WINTER LEGUMES FOR THE SOUTH.

A greater use of winter legumes in the South, especially crimson clover and vetch, is being encouraged as much as possible. Hairy vetch has in general given much more satisfactory results than common vetch, although in extensive areas the latter is perfectly satisfactory. Crimson clover seems to be much better adapted to the soils of the Coastal Plains region than it is farther westward. This, however, may be partly due to lack of inoculation. In general, however, the results indicate that the areas of the soil types where one or the other of these legumes is preferable may be definitely mapped.

CONGRESSIONAL SEED DISTRIBUTION.

The regular Congressional distribution of seeds and plants as made during the past season included vegetable, flower, cotton, and lawn-grass seed, bulbs, grapevines, and strawberry plants. There were also distributed small quantities of selected varieties of tobacco seed and a number of varieties of the new hybrid citrus trees.

VEGETABLE AND FLOWER SEED.—The work of packeting, assembling, and mailing the vegetable and flower seed was awarded under contract to Cole & Westwood, Fredonia, N. Y., at $1.18½ per 1,000 packets. The work was begun on September 9, 1907, and completed on May 11, 1908, and entailed the putting up of 33,411,520 packets of vegetable seed and 4,676,360 packets of flower seed. A new style of packeting machine was used by the above-mentioned firm, which accounts for the work being started earlier than in previous years. The delay in completing the work was due to a disastrous fire which occurred in the warehouse where this work was done on November 6, 1907. The fire destroyed the work completed by the contractor up to that time, as well as a considerable quantity of bulk seed.

COTTON SEED.—The cotton seed used in the distribution was selected by Dr. D. N. Shoemaker, Expert in Charge of Cotton Breeding Investigations, and included ten varieties, some of which are new. In addition to these varieties, there was distributed a small quantity of wilt-resisting varieties of cotton developed by Mr. W. A. Orton, Pathologist. This seed was sent only to those sections where cotton wilt was prevalent.

LAWN-GRASS SEED.—The usual distribution of lawn-grass seed was made, seed of Bermuda grass being sent to the Gulf States and to the Southwest, as this seed has given the most satisfactory results in these sections. To all other localities a mixture consisting of Kentucky bluegrass, redtop, and white clover was sent. A total of 15,250 packages of grass seed was sent out.

BULBS.—Fall-planting bulbs were distributed. These consisted of hyacinth, tulip, and narcissus bulbs procured from Holland and put up in boxes containing 20 bulbs of assorted varieties. Some American-grown narcissus bulbs were secured, which were utilized in the distribution. The total number of boxes distributed was 10,604.

GRAPEVINES AND STRAWBERRY PLANTS.—A list was prepared covering the most suitable varieties of grapevines and strawberry plants, and these were grown for distribution. This list covered 23 varieties of grapevines and 25 varieties of strawberry plants, aggregating a total of 24,350 grapevines and 91,000 strawberry plants for distribution.

TOBACCO SEED.—The tobacco seed distributed during the past season was purchased on the recommendation of Mr. A. D. Shamel, Physiologist in Charge of Tobacco Investigations, who examined the growing crop and made selection of plants from which to obtain seed, thus insuring seed thoroughly typical of the varieties sent out. The seed included not only standard varieties, but new and improved varieties developed under the supervision of Mr. Shamel. Tobacco seed is sent to those persons specially recommended by Representatives and Senators, who are requested to send in only the names of those who are interested in this crop. This arrangement is working very well and places the seed with those most interested and at the same time enables the Department to get definite reports as to the results. It also frequently results in securing valuable men who are willing to cooperate with the Department in conducting further experiments in tobacco work.

CITRUS TREES.—Varieties of the new hardy oranges, or citranges, developed by Dr. H. J. Webber, were distributed in those sections where it was found possible to make arrangements to have them tested.

MISCELLANEOUS DISTRIBUTION.—Prof. C. C. Georgeson, Director of the Alaska Agricultural Experiment Stations, reported satisfactory results from the distribution of seeds heretofore made in Alaska. This distribution was continued and, in addition, an assortment of flower seeds was included.

BULB PROPAGATING GARDEN.—It having been demonstrated that the propagation of Dutch bulbs is a possibility in the Puget Sound region, it was decided to undertake this work on a more definite basis. In order to do this it was deemed best to have a suitable tract of land exclusively under the control of the Department. Such a tract, consisting of 10 acres, was located near the city of Bellingham, Wash., and the people of that city, through the Chamber of Commerce, secured a lease of this tract for a period of ten years and tendered the same to the Department. The offer was accepted with the understanding that the tract was to be put in proper shape for the work contemplated, a suitable dwelling house erected thereon for the superintendent of the garden, and such other buildings and improvements made as were necessary. The tract with all improvements was to be leased to the Department at a nominal rental, and the Chamber of Commerce was to take care of any taxes and assessments against the property during the life of the lease. This lease has been made and the work of grading and clearing such part of the tract as required it is now under way, the superintendent's house is nearing completion, wells are being driven with a view to securing ample water supply for all purposes, and every effort is being made to carry out the terms of the lease.

The Department has placed in Holland an order for bulbs with which to begin the work of propagating and testing the coming fall. It is hoped under this project to secure bulbs for Congressional distribution, to show whether or not Dutch bulbs can be profitably grown on a commercial scale in the Puget Sound region, and to secure considerable data, which is now lacking, in connection with this industry, particularly as to methods of cultivating, manuring, best soil conditions for each class of bulbs, etc. In about five years it is probable that a sufficient number of bulbs from this work will have been secured to begin making a distribution through the usual channels.

SPECIAL TESTING GARDENS IN THE FIELD.

In addition to the field stations already referred to throughout this report, the Bureau of Plant Industry maintains several special gardens where considerable testing and other work are under way. These are briefly referred to in the following paragraphs.

SUBTROPICAL LABORATORY AND GARDEN, MIAMI, FLA.

The work of the Subtropical Laboratory and Garden, Miami, Fla., has continued under the supervision of Dr. E. A. Bessey, Pathologist. The drought which began in December, 1906, continued until about the middle of May, 1908, seriously interfering with the investigations carried on at Miami.

NEMATODE INVESTIGATIONS.—Experiments for the control and for the further study of the root-knot nematode (*Heterodera radicicola*) were carried on as in the preceding year at both Miami, Fla., and Monetta, S. C. The number of plants known to be subject to its attack has been increased to nearly 400, two-thirds of which were personally observed by the pathologist in charge. These nematodes were found to be more widely distributed than had been assumed earlier, having been found growing out of doors on ginseng in the northern part of Indiana and New York, and on the same host even in the upper peninsula of Michigan. Cultural experiments in sterilized soil with these nematodes from Indiana appear to demonstrate their identity with those found in southern Florida. Experiments carried on under the direction of the pathologist in charge by a farmer in Texas showed that in that region, at least, a two years' rotation in nonsusceptible crops would rid the soil of the pest. He sowed winter oats two successive falls and Iron cowpeas the following summers, carefully removing all weeds that might harbor the pest. The third summer cantaloupes planted in the field were not affected, although three years previously they had been destroyed by nematodes.

A trip was made to the sugar-beet districts of Kansas, Colorado, Utah, Idaho, California, and Nebraska to determine the extent of the distribution of the very destructive European sugar-beet nematode (*Heterodera schachtii*). It was found in two places in California and in several localities in Utah. The affected fields were very seriously infested. In no other localities were any signs of the trouble discovered. It occurred only where sugar beets had been grown a number of times upon the same land. Rational rotation of crops, by preventing the multiplication of the few nematodes introduced to the field, seems to be the reason for the nonappearance of the disease elsewhere. Every indication leads to the conclusion that the nematodes are introduced in the soil which is to be found in nearly every bag of seed imported from abroad.

DISEASES OF TROPICAL AND SUBTROPICAL PLANTS.—Work has been largely confined to *Colletotrichum gloeosporioides*, causing serious diseases of citrus trees, mangos, avocados, and other tropical plants. It was demonstrated that anything that reduced the vigor of these plants in any way made them easy victims of this disease, while, on the contrary, a vigorous tree is rarely attacked, if the disease is not too prevalent, except in its blossoms. Drought, insect injury, improper fertilizers, and other fungous diseases may all lead to serious injury by this fungus.

Improvement of tropical fruits.—The roselle selection was continued by the gardener, Mr. P. J. Wester, and sufficient seed of the improved variety, to which the name Victor was given, was obtained to make a fairly abundant distribution throughout the region adapted to its culture. Not only the fleshy calyces, but even the young twigs and leaves were found to be usable for jelly and jam making. A farmers' bulletin on the subject was issued by Mr. Wester during the year.

The various species of anona were made the subject of work by Mr. Wester. Crosses between the different species were attempted with some success. It is hoped that some desirable new fruits may be produced in this way. By hand-pollination the cherimoyer, which has hitherto never fruited in Florida, was made to set fruit, the ripening of which is eagerly awaited.

At the direction of the pathologist in charge, experiments were made to determine whether the native *Ficus aurea* can be used as a stock for the fig. This species is less injured by the root-knot nematode than is the fig. It was shown that the seeds of *Ficus aurea* germinate only in the light, a point to be considered in growing this plant for stocks. The experiments are not yet completed.

An apparently new and successful method of budding the mango has been devised by a mango grower near Miami, and extensive experiments are being made to determine whether it will prove practicable for general use.

Pineapple hybrids.—The growing and testing of the pineapple hybrids originated by Dr. H. J. Webber have been continued in cooperation with him, and two or three more sorts of superior quality have been selected and named. A second distribution of selected sorts was made to growers in various parts of Florida in August, 1907, and will be repeated in 1908.

Plant introductions.—Many plants imported by the Office of Foreign Seed and Plant Introduction have been grown at the Subtropical Laboratory and Garden. The following are worthy of note: The Sundersha mango fruited again, showing that the variety yields well. Some of the fruit weighed 30 to 32 ounces. It is the latest variety known in Florida, ripening from the latter part of August to the middle of September. The Totafari fruited for the first time in Florida. Its fruits are practically fiberless, of a very delicate flavor, and of medium size, 11 to 13 ounces. The carob (*Ceratonia siliqua*) fruited abundantly last summer and late this spring. It proves to be perfectly hardy in the climate of southern and central Florida.

SOUTH TEXAS GARDEN, BROWNSVILLE, TEX.

The work of this garden has made very satisfactory progress under the immediate charge of Prof. E. C. Green, Pomologist. From June, 1907, when operations were begun, until the end of the fiscal year 1908, 1,593 letters were received at this office and 1,369 letters written. The land assigned by the War Department was an abandoned cavalry and artillery parade ground, covered with a heavy growth of Bermuda grass, brush, and cactus. About 50 acres were grubbed, cleared, plowed repeatedly, graded, and prepared for irrigation. A half mile of road was made extending the length of the garden, and about three-fourths of a mile of laterals for irrigation were built. Horses, mules, implements, office furniture, and equipment were secured, and an irrigation and lighting plant and a water-supply system were installed. The buildings assigned to the Department of Agriculture were repaired and remodeled for a power plant, a tool room, and offices. A propagating house 20 by 50 feet and cold frames were erected. In November of 1907 the land and irrigation equipment were ready and the first field planting was made.

Plantings at the garden.—At the end of the fiscal year there had been received and planted at the garden 1,482 different varieties of trees, shrubs, plants, and seeds from various sources, about 40 acres being in growing crops at that time. Of oranges, figs, almonds, and other fruits and nuts for permanent orchard, 110 varieties were planted and a vineyard established containing 223 varieties of grapes. About 10 acres were devoted to forage crop tests, several foreign varieties of forage plants being tried with and without irrigation. The mung bean and guar from the Orient give promise of value as leguminous crops for south Texas, where irrigation is impossible. Several hundred varieties of vegetables were tested during the year, and several of them created considerable interest among the truck gardeners. The Marnapolka cabbage from Holland attracted special attention, and some growers have arranged to secure seed and give this variety an extensive commercial test the coming year.

One of the best collections of opuntias in the world has been started and is making an excellent showing. The ranchmen of the section are interested in this test, especially in the spineless varieties.

Fifteen varieties of long-staple and Egyptian cottons are being grown for breeding purposes. The best native corn was secured as a basis for corn breeding and selection, and about an acre was devoted to this work.

A nursery has been established, and apple, pear, orange, persimmon, mulberry, date, Kafir plum, Queensland nut, and cork-oak trees are growing very successfully. Some of the seedling fruit trees have been budded from scions sent by foreign explorers.

Seven species of fiber plants have been started and are making satisfactory growth. Besides the forage crops referred to, several species and varieties of grasses have been planted. Great interest has been manifested in the Para grass and some distribution of it has been made to planters in south Texas.

Several species of bamboo and a great many foreign plants have been propagated. Crops of seed of some of the latter are growing and should be available for distribution next year.

Twelve varieties of aquatics have been established, of which several have blossomed and produced seed. A large number of seedlings should be available for distribution the coming season.

Cooperation with farmers.—Since the establishment of the garden, the farmers and fruit and truck growers of the Gulf coast and the Rio Grande Valley have organized themselves into a society known as the South Texas Gardeners, which has its home and holds its annual meeting on the grounds of the South Texas Garden. This society is educational in its nature and manifests a lively interest in the progress and development of the South Texas Garden. This arrangement tends to develop a close relationship between the practical growers and the garden employees, which results beneficially to all. Insect and plant disease outbreaks are promptly reported to the garden by the society members from various parts of south Texas. Advice is given in return and warnings sent to other localities, advising each of the outbreak and making timely suggestions.

By cooperation with the Bureau of Entomology, the South Texas Garden was enabled to have a permanent entomologist stationed there the greater part of the year. This arrangement was very beneficial to the garden, in that the entomologist gave much of his time to protecting valuable plants against attacks of insects. His work was especially appreciated and valued by the farmers and fruit growers of the section. He visited their farms when insect outbreaks occurred and advised and assisted them in the control of the pests.

Plans for future work.—In response to urgent solicitation from business men and farmers, it is planned to develop cooperative gardens at several different points along the Gulf coast and in the Rio Grande Valley. This extension of the sphere of usefulness of the South Texas Garden may be accomplished at little expense to the Department, as the interested parties freely offer the necessary land and the money for equipment and maintenance.

There is an understanding with the Bureau of Entomology that an entomologist will be permanently stationed at the garden the coming year. It is hoped that arrangements may be made by which a plant pathologist may also be permanently stationed there. Thousands of dollars' worth of celery, cantaloupes, etc., were lost to the growers last season on account of fungous diseases, some of which could have been controlled had a man been on the ground to prompt the farmers to action at the right time and advise and assist them.

PLANT INTRODUCTION GARDEN, CHICO, CAL.

This garden, which is now in charge of Mr. W. W. Tracy, jr., Assistant Botanist, is maintained principally as a propagating and plant introduction station for the propagation and distribution of new and valuable plants. During the past year over 300 kinds of plants and seeds have been received from various explorers and experimenters. These importations are now being grown as fast as possible for fall distribution to all those who wish to experiment with plants of possible value to their communities. A large number of these new plants were collected in northern China and Manchuria. Among them are the most extensive and varied collection of bamboos ever brought to this country, a pure white-bark pine, and a number of new lilacs, roses, and ornamental lemons.

Plant propagation.—The propagation of plants for free distribution includes this year over 300 different species and varieties. Among the samples now ready for the coming winter's distribution are 800 *Actinidia chinensis*, a new ornamental climber from China, which is said to bear fruits combining the flavor of the gooseberry, citron, and fig; 1,600 *Aleurites cordata*, sometimes called the national tree of China, and from which the wood oil of commerce is obtained; 3,000 *Amygdalus persica*, a new wild peach from China, said to be an extremely hardy and drought-resistant stock for grafting peaches, almonds, prunes, and plums; 1,000 unnamed *Clematis*, and 4,000 *Pistacia chinensis*, which produces the costly pistache nut of the confectioners. These plants are distributed, as far as it is possible to determine, only to those who give them a good trial. With so large a number of plants distributed over as great a range of country as the coming distribution contemplates, it is very likely that some of the introductions will find localities where they will succeed perhaps better than some of the crops now locally cultivated.

PLANT INTRODUCTIONS.—Another interesting part of the work of the garden is the planting of two specimens of as many of the new introductions as can be handled. During the past year, the permanent orchard plantings have been increased to 325 new species and varieties. Many of these are found nowhere else in this country, and include a great range of different kinds of fruits and ornamentals. In a few years many of them will be in fruit and flowering condition, forming not only an interesting sight for the casual visitor but a valuable study for horticulturists and botanists as well.

COOPERATIVE WORK.—Besides the work of the Office of Foreign Seed and Plant Introduction this garden also carries on experiments for other offices of the Department. The development of a profitable strain of corn for California and of more productive strains of alfalfa; the discovery of grasses and forage crops best adapted to this valley and the best methods of cultivation of the same; the selection, propagation, and free distribution of opuntias of the spineless variety suitable for stock feeding; the maintenance of a variety collection of figs and grapes; experiments on cotton; and the determination of the different effects of California climate and soil on vegetable varieties are still being continued as heretofore. The plantings at the garden now number over 1,400 samples.

IMPROVEMENT OF THE GARDEN.—On account of insufficient appropriations, the general improvement of the garden has not progressed during the past season as rapidly as the work has required. There has, however, been some work accomplished in grading the land, and the task of lawn making, road building, laying of permanent irrigating pipes, and general ornamentation of the garden is now ready to be taken up seriously. The necessity of a well-equipped station at this place becomes very important, because of the great number of new settlers coming into this region to locate on the large wheat farms, which are now being rapidly subdivided and irrigated and set out to orchards and gardens devoted to various kinds of intensive farming. Throughout the great Sacramento Valley, comprising an agricultural area almost as large as some eastern States and capable of supporting under irrigation millions instead of thousands of people, there is not at present a single agricultural station demonstrating the varied possibilities of this wonderful region, except the Department garden at Chico. Prospective settlers, therefore, naturally come to this garden in large numbers to inquire what can be accomplished in this valley, but as this place is strictly a propagating and plant introduction garden and not a demonstration or general agricultural station, it is possible to answer our visitors' questions only partially. Nevertheless, much assistance can be rendered to settlers by growing to perfection all plants received from agricultural explorers and making the place interesting and attractive. As the garden is now supplied with many of the necessary buildings and equipment, it will require only a little more expenditure of money and a few years more to attain the original purpose of this garden, in making it a place capable of propagating, distributing, and growing rapidly all the great varieties of plants collected by explorers in all parts of the world, and of serving as a record station of all introductions.

Plans for future work.—The work of the garden for the coming year contemplates a continuation of the experimental work of previous years and additions to present buildings and equipment, especially the remodeling of the propagating houses, laying of underground pipes for irrigation, additional grading of land, and general ornamentation of the whole place. The propagation of the present shipment of bamboos and other plants which are yet to arrive and a variety test of casabas, or winter muskmelons, thought to be of great promise for extensive eastern shipment, will be prominent features of next season's work.

REPORT OF THE FORESTER.

U. S. Department of Agriculture,
Forest Service,
Washington, D. C., December 1, 1908.

Sir: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1908, together with an outline of the plans for the work of the Service for the current fiscal year.

Respectfully,
Gifford Pinchot, *Forester.*

Hon. James Wilson,
Secretary of Agriculture.

FIELDS OF WORK AND CLASSIFICATION OF EXPENDITURES.

Since February 1, 1905, the work of the Forest Service has included both the protection and administration of the National Forests and the promotion throughout the United States of the best use of all forests and forest products.

Neither the organization of the Service nor the yearly reports of expenditures make distinction between these two fields of activity, for the reason that the same lines of work run through both fields. The problems of forest management, for example, call for investigations both on National Forests and on private lands. To make these investigations through two distinct branches of the Service organization and pay for them from separate funds would result in needless work, duplication of facilities, and a seriously increased demand for trained foresters to equip a staff already too small. The reports of expenditures are made in complete detail, and also in summary, under the requirement of the act of March 3, 1885, and in another form in connection with the estimates of appropriations called for by the act of March 4, 1907; but in neither case does the grouping serve to show how much is expended upon National Forest work in the West and how much upon Federal cooperation, forest investigations, and the dissemination of the knowledge gathered.

The following statement presents a classification of the Forest Service expenditures to bring this out. In connection with the estimates submitted for 1910 an appendix has been prepared which presents a similar classification, itemized under each head.

Forest Service expenditures, fiscal year 1908.

Administration and protection of National Forests	$2,526,098.02
Permanent improvements National Forests	592,169.19
Federal cooperation	6,319.38
Forest investigations	235,855.14
Diffusion of information	55,665.88
Total disbursements from appropriations on account of work of the Forest Service	3,416,107.61
Disbursed from cooperative funds	23,417.48
Total expenditures for Forest work	3,439,525.09

Disbursed for other purposes:	
Payments to States of 10 per cent of receipts from National Forests for fiscal year 1907	$153,032.19
Refunds to depositors of excess deposits	48,678.61
Total disbursements for all purposes	3,641,235.89
Unexpended balance of appropriations	20,973.11
Total of sums available for all disbursements of the year	3,662,209.00

The expenditures from appropriations were derived from the following sources:

Agricultural appropriation act ($1,900,000, less unexpended balance of $13,414.72)	$1,886,585.28
Agricultural appropriation act ($500,000 available for permanent improvements, less $6,213.21, expended before July 1, 1907)	493,786.79
Agricultural appropriation act (balance of appropriation for Appalachian survey, etc., carried over from fiscal year 1907, less unexpended balance of $7,558.39)	15,845.37
Receipts from National Forests before July 1, 1907, appropriated to Forest Service, less payments to States of $153,032.19	1,019,890.17
Total disbursed from appropriations on account of work of the Forest Service	3,416,107.61

The unexpended balances of appropriations are, under the law, available for two years to meet any outstanding liabilities of the year 1908, but will for the most part revert to the general fund of the Treasury.

The amounts paid the States and Territories, to be expended for roads and schools, from the receipts of the year 1907, were as shown below. For purposes of comparison, the amounts payable from the receipts for 1908, under the provision of law increasing the share of the States to 25 per cent of the gross receipts, are shown in the second column.

State.	Amount paid 1907.	Amount payable 1906.[a]	Increase.	State.	Amount paid 1907.	Amount payable 1908.[a]	Increase.
	10 per cent.	25 per cent.			10 per cent.	25 per cent.	
Arkansas		$313.68	$313.68	Nevada	$2,133.98	$4,577.95	$2,443.97
Alaska	$367.15	2,684.78	2,317.63	New Mexico	9,614.06	25,464.12	15,850.06
Arizona	17,307.92	42,610.44	25,302.52	Oklahoma	125.50	554.48	428.98
California	16,064.29	52,437.78	36,373.49	Oregon	13,980.89	32,313.52	18,332.63
Colorado	15,791.67	50,955.67	35,164.00	South Dakota	2,752.23	8,456.60	5,704.37
Idaho	19,591.66	56,307.84	36,716.18	Utah	13,557.38	32,151.03	18,593.65
Kansas	119.39	643.55	524.16	Washington	3,731.55	18,032.79	14,301.24
Minnesota				Wyoming	16,221.49	41,402.38	25,180.89
Montana	20,655.42	75,807.41	55,151.99				
Nebraska	1,017.61	2,349.77	1,332.18	Total	153,032.19	447,063.79	294,031.62

[a] Subject to change by Treasury Department in adjustment between States.

THE NATIONAL FORESTS.

AREA.

The net result of the additions, eliminations, and new Forests created during the year by presidential proclamation was to increase the total area of National Forests by 17,142,941 acres.

The following table shows in detail the changes made:

National Forests, showing new Forests, additions, and eliminations, July 1, 1907, to June 30, 1908.

State.	Forest.	Area July 1, 1907.	Changes in area by proclamations, July 1, 1907, to June 30, 1908.		Area July 1, 1908.
			New Forests and additions.	Eliminations.	
		Acres.	*Acres.*	*Acres.*	*Acres.*
Arizona	Baboquivari	126,720			126,720
	Black Mesa	2,030,240	542,009		2,572,249
	Chiricahua	287,520			287,520
	Dixie		626,800		626,800
	Dragoon	69,120			69,120
	Grand Canyon	2,257,920			2,257,920
	Huachuca	314,125			314,125
	Mount Graham	140,880			140,880
	Pinal Mountains[a]	45,760			
	Prescott	423,680	319,808		743,488
	San Francisco Mountains	1,975,310			1,975,310
	Santa Catalina	155,520	251,170		406,690
	Santa Rita	490,558			490,558
	Tonto	1,115,200	1,288,320		2,449,280
	Tumacacori	203,550			203,550
	Verde		721,780		721,780
		9,636,103	3,749,887		13,385,990
Arkansas	Arkansas		1,078,955		1,078,955
	Ozark		917,944		917,944
			1,991,899		1,991,899
California	Diamond Mountains	649,838			649,838
	Inyo	221,324			221,324
	Klamath	1,896,313			1,896,313
	Lassen Peak	897,115	141,881		1,038,996
	Modoc	288,218	570,800		859,018
	Monterey	335,195	25,105		360,300
	Pinnacles	14,108			14,108
	Plumas	787,742			787,742
	San Benito		140 069		140,069
	San Bernardino	737,120	28,680		765,800
	San Gabriel	555,395	67,425		622,820
	San Jacinto	1,751,439			1,751,439
	San Luis Obispo	368,850			368,850
	Santa Barbara	1,982,100			1,982,100
	Shasta	1,523,770			1,523,770
	Sierra	5,049,934	1,553,419	5,760	6,597,593
	Stanislaus	1,296,800	348,570		1,645,370
	Stony Creek	937,569			937,569
	Tahoe	1,394,772			1,394,772
	Trabuco Canyon	109,920	43,467		153,387
	Trinity	1,248,042	350,471		1,598,513
	Warner Mountains	306,518			306,518
		22,341,582	3,269,887	5,760	25,605,709
Colorado	Battlement Mesa	797,720			797,720
	Cochetopa	1,133,830			1,133,830
	Fruita	7,680			7,680
	Gunnison	901,270			901,270
	Holy Cross	1,061,280			1,061,280
	La Salle	29,502			29,502
	Las Animas	196,140			196,140
	Leadville	1,219,947			1,219,947
	Medicine Bow	1,346,155			1,346,155
	Montezuma	1,612,146			1,612,146
	Ouray	273,175			273,175
	Park Range	1,133,686			1,133,686
	Pikes Peak	1,681,667			1,681,667
	San Isabel	321,227			321,227
	San Juan	2,203,918		1,840	2,202,078
	Uncompahgre	619,428			619,428
	Wet Mountains	239,621			239,621
	White River	970,880			970,880
		15,748,772		1,840	15,746,932

[a] Pinal Mountains included in Tonto January 13, 1908.

National Forests, showing new Forests, additions, and eliminations, etc.—**Cont'd.**

State.	Forest.	Area July 1, 1907.	Changes in area by proclamations, July 1, 1907, to June 30, 1908.		Area July 1, 1908.
			New Forests and additions.	Eliminations.	
		Acres.	*Acres.*	*Acres.*	*Acres.*
Idaho	Bear River	415,360			415,360
	Big Hole	304,140			304,140
	Bitter Root	3,860,960			3,860,960
	Cabinet	494,560			494,560
	Caribou	733,000			733,000
	Cassia	326,160			326,160
	Coeur d'Alene	2,331,280			2,331,280
	Henrys Lake	798,720			798,720
	Kootenai	165,242			165,242
	Lemhi	1,344,800			1,344,800
	Palouse	194,404			194,404
	Payette	1,460,960			1,460,960
	Pocatello	49,920			49,920
	Port Neuf	99,508			99,508
	Priest River	815,100			815,100
	Raft River	293,044			293,044
	Salmon River	1,879,680			1,879,680
	Sawtooth	3,340,160			3,340,160
	Weiser	1,126,429			1,126,429
	Yellowstone	303,000			303,000
		20,336,427			20,336,427
Kansas	Garden City[a]	97,280			
	Kansas		205,107		302,387
Minnesota	Minnesota		294,752		294,752
Montana	Big Belt	641,460			641,460
	Big Hole	1,612,960			1,612,960
	Bitter Root	691,920			691,920
	Cabinet	1,566,400			1,566,400
	Crazy Mountains	234,760			234,760
	Ekalaka	33,808			33,808
	Elkhorn	186,240			186,240
	Gallatin	888,660			888,660
	Helena	782,160			782,160
	Hell Gate	1,582,400			1,582,400
	Highwood Mountains	45,080			45,080
	Kootenai	887,360			887,360
	Lewis and Clark	5,541,180			5,541,180
	Little Belt	1,053,160			1,053,160
	Little Rockies	31,000			31,000
	Lolo	1,211,680			1,211,680
	Long Pine	111,445			111,445
	Madison	958,800			958,800
	Missoula	194,430			194,430
	Otter	590,720			590,720
	Pryor Mountains	78,733			78,733
	Snowy Mountains	126,080			126,080
	Yellowstone	1,352,240			1,352,240
		20,402,676			20,402,676
Nebraska	Dismal River	85,123			85,123
	Niobrara	123,779			123,779
	North Platte	347,170			347,170
		556,072			556,072
Nevada	Charleston	149,165			149,165
	Independence	135,019			135,019
	Monitor	572,640			572,640
	Ruby Mountains	423,660			423,660
	Sierra		62,573		62,573
	Tahoe	59,115			59,115
	Toiyabe	625,040			625,040
	Toquima	368,000			368,000
	Vegas		195,840		195,840
		2,332,639	258,413		2,591,052

[a] Garden City included in Kansas, May 15, 1908.

National Forests, showing new Forests, additions, and eliminations, etc.—Cont'd.

State.	Forest.	Area July 1, 1907.	Changes in area by proclamations, July 1, 1907, to June 30, 1908.		Area July 1, 1908.
			New Forests and additions.	Eliminations.	
		Acres.	*Acres.*	*Acres.*	*Acres.*
New Mexico	Big Burros [a]	156,780			
	Datil		39,000		[b] 1,270,500
	Gallinas	78,480			78,480
	Gila	[c] 2,823,900	28,180	2,554	[a] 1,774,801
	Guadalupe	283,065			283,065
	Jemez	1,460,245	197,120		1,657,365
	Lincoln	627,435		109,312	518,123
	Las Animas	480			480
	Magdalena	153,782			153,782
	Manzano	459,726	184,015	167,156	[d] 587,110
	Mount Taylor	110,525			
	Pecos River	430,880			430,880
	Peloncillo	178,977			178,977
	Sacramento	881,841			881,841
	San Mateo	424,663			424,663
	Taos	233,200			233,200
		8,303,979	448,315	279,027	8,473,267
Oklahoma	Wichita	60,800			60,800
Oregon	Ashland	172,800			172,800
	Blue Mountains	3,603,920		131,643	3,472,277
	Bull Run	142,080			142,080
	Cascade	5,886,840			5,886,840
	Coquille	148,317			148,317
	Fremont	1,235,720			1,235,720
	Goose Lake	630,000			630,000
	Heppner	292,176			292,176
	Imnaha	1,750,240			1,750,240
	Siskiyou	1,132,582			1,132,582
	Tillamook	175,518			175,518
	Umpqua	798,400			798,400
	Wenaha	494,942			494,942
		16,463,535		131,643	16,331,892
South Dakota	Black Hills	1,163,160			1,163,160
	Cave Hills	23,360			23,360
	Short Pine	19,040			19,040
	Slim Buttes	58,160			58,160
		1,263,720			1,263,720
Utah	Aquarius	639,000	87,150		726,159
	Bear River	267,920			267,920
	Beaver	286,699			286,699
	Dixie	465,920		1,600	464,320
	Fillmore	399,600			399,600
	Fish Lake	363,337			363,337
	Glenwood	173,896			178,896
	Grantsville	68,960			68,960
	La Salle	128,960			128,960
	Manti	786,080			786,080
	Monticello	214,270	101,398		315,668
	Payson	167,280			167,280
	Raft River	117,203			117,203
	Salt Lake	95,440			95,440
	Sevier	710,920			710,920
	Uinta	2,187,550			2,187,550
	Vernon	68,800			68,800
	Wasatch	85,440			85,440
		2,227,275	188,557	1,600	7,414,232
Washington	Colville	869,520			869,520
	Olympic	1,594,560			1,594,560
	Priest River	406,520			406,520
	Rainier	2,565,760			2,565,760
	Washington	6,310,740			6,310,740
	Wenaha	318,400			318,400
		12,065,500			12,065,500

[a] Big Burros, 156,780 acres, included in Gila, June 18, 1908.
[b] Includes 1,231,500 acres transferred from Gila, June 18, 1908.
[c] Includes 1,231,500 acres transferred to Datil, June 18, 1908.
[d] Mount Taylor included in Manzano, April 16, 1908.

National Forests, showing new Forests, additions, and eliminations, etc.—Cont'd.

State.	Forest.	Area July 1, 1907.	Changes in area by proclamations, July 1, 1907, to June 30, 1908.		Area July 1, 1908.
			New Forests and additions.	Eliminations.	
		Acres.	*Acres.*	*Acres.*	*Acres.*
Wyoming	Bear Lodge	186,784			186,784
	Big Horn	1,151,680			1,151,680
	Black Hills	46,440			46,440
	Caribou	7,740			7,740
	Crow Creek	56,820			56,820
	Medicine Bow	583,364		21,752	561,612
	Sierra Madre	370,911			370,911
	Uinta	4,596			4,596
	Yellowstone	6,662,640			6,662,640
	Total in United States.	145,856,835	10,406,817	441,622	155,822,030
Alaska	Afognak	403,640			403,640
	Alexander Archipelago	4,506,240		11,878	4,494,362
	Chugach		4,960,000	33,000	4,927,000
	Tongas		2,262,624		2,262,624
		4,909,880	7,222,624	44,878	12,087,626
Porto Rico	Luquillo	65,950			65,950
	Grand total	150,832,665	17,629,441	486,500	167,975,606

LEGAL STATUS.

TITLES, CLAIMS, AND SETTLEMENT.

The National Forest areas already given are gross—that is, they take no account of alienations and unperfected claims included within the proclaimed boundaries. For administrative purposes it is important that the status of all the land within National Forest boundaries should be accurately known. Through the section of status the Forest Service secures from the General Land Office the information on record concerning land titles in National Forests, and through the section of claims information as to the validity of claims not yet patented. As fast as knowledge of alienations is secured it is entered on the atlas sheets of the various Forests.

The alienations now determined within the boundaries of National Forests aggregate 6,306,809 acres. Judging from the data hitherto collected, about 21,000,000 acres of the present National Forest area is alienated land. It is expected that by the close of the calendar year 1908 the location of all alienations will have been determined.

Field examinations of 7,672 unpatented claims led to reports to the General Land Office concerning 6,243, as follows:

Action recommended.	Homestead entry.	Desert-land entry.	Timber and stone.	Lode mining.	Placer mining.	Coal land.	Miscellaneous.	Total.
Favorable	1,181	73	897	1,709	110	67	75	4,112
Unfavorable	1,057	43	74	389	168	17	232	1,980
Further inquiry	54		12	38	2			106
No recommendation	26		14	3		1	1	45
Total								6,243

Recommendations made by the Forest Service in no sense determine the action to be taken, but put at the disposal of the General Land Office any information possessed by the Forest Service which throws light on the legality of the claim. The Forest Service simply reports the facts. Geologists detailed by the Geological Survey and expert miners employed by the Forest Service assisted in the examinations of mining claims. The examinations made led to the restoration to the National Forests of 50,504 acres of land, bearing more than 330,000,000 board feet of merchantable timber. Of this timber 24,280,000 feet was claimed under the timber and stone act, while three single mining claims bore respectively 9,000,000, 10,000,000, and 11,000,000 board feet.

In addition to examining claims, the Forest Service is charged with the duty of examining lands applied for under the act of June 11, 1906, to learn whether they are in fact more valuable for agriculture or for timber.

The total National Forest area listed for settlement under this act has been 295,007 acres, of which 238,945 acres were listed last year. Recommendations in favor of listing have followed the examination in 58 per cent of the cases.

The number of applications received during the year was 5,271, as against 2,721 previously received. The increase was largely due to the act of May 30, 1908, which extended the provision of the act of June 11, 1906, to all the National Forests in California except in San Luis Obispo and Santa Barbara counties. This act brought in a large number of applications too late to be acted on before the close of the year. On June 30, 2,799 applications awaited action, for many of which the field examinations had been completed.

A marked change in the character of the applications is taking place, and it is expected that by the close of the present field season the proportion of applications made for the bona fide purpose of securing homes, as distinguished from applications made for speculative purposes, will be much larger than in the past.

There were selected and withdrawn from entry and settlement during the year 1,675 rangers' headquarters on 164 Forests.

COURT AND ADMINISTRATIVE DECISIONS AFFECTING NATIONAL FORESTS.

An important Federal decision affecting National Forests was rendered by the Circuit Court of Appeals (160 Fed. Rep., 870) affirming the decision of the lower court in the case of the United States *v.* Shannon (151 Fed. Rep., 863). This decision held that National Forests are not subject to State fence laws.

It was decided by the Comptroller of the Treasury that the appropriation for general expenses of the Forest Service is available for the administration of the Luquillo National Forest in Porto Rico.

On October 5, 1907, the Attorney-General upheld the authority of the Secretary of Agriculture to charge for the use of lands especially valuable for power-plant purposes.

ENFORCEMENT OF LAW.

Assistance was given the Department of the Interior before and at hearings on alleged invalid or fraudulent claims on National Forests. The most important of these cases was that against H. H. Yard and the North California Mining Company, involving mineral locations for approximately 11,000 acres of heavily timbered land in the Plumas National Forest.

There were litigated or recommended for litigation in Federal and State courts 41 cases of timber trespass, 26 of grazing trespass, 21 of special-use trespass, 10 each of fence and fire trespass, and 14 of miscellaneous character, including 5 cases in which the intervention of the United States was requested in suits between individuals. Of these suits 7 civil and 8 criminal were won, 7 criminal were lost, 4 civil and 11 criminal were dropped, 12 suits were settled, and 73 are pending.

In July, 1907, J. C. Teller, who had been indicted for a timber trespass on the Medicine Bow (now the Cheyenne) National Forest, relieved himself from further criminal liability by paying for the trespass at the rate of $2.50 an acre (or about $1,700) for the land described in the indictment under the act of June 3, 1878. Civil action was brought and is now pending against Teller and the Union Pacific Railroad Company in the United States district court of Colorado for about $180,000. This trepass was committed before the lands were included in a National Forest.

COST AND USE.

The following table shows the cost of administration, expenditures for permanent improvements, and receipts from the several sources, both in totals and per acre, during the past year, as compared with those for the fiscal year 1907:

Fiscal year.	Expenditures.			
	Administration and protection.		Permanent improvements.	
	Total.	Per acre.	Total.	Per acre.
1908	$2,526,098.02	$0.01503	$592,169.19	$0.00353
1907	1,455,329.10	.0096	83,090.21	.00065

Fiscal year.	Receipts.							
	Grazing.		Timber sales.		Special uses.		All sources.	
	Total.	Per acre.	Total.	Per acre.	Total.	Per acre.	Total.	Per acre.
1908	$962,829.40	$0.00573	$849,027.24	$0.00505	$30,425.23	$0.00018	$1,842,281.87	$0.01096
1907	863.920.32	.00572	686,813.12	.00455	20,326.00	.00013	1,571,059.44	.01041

The grazing receipts for 1908 were paid by the holders of 19,845 permits to graze 1,382,221 cattle, horses, and hogs, and of 4,282 permits to graze 7,087,111 sheep and goats. The receipts from timber sales were paid by approximately 5,189 purchasers, who cut the equivalent of 392,792,000 board feet of timber. The receipts from special uses were paid by 2,065 permittees. In other words, these receipts represent profitable use of the Forests by some 30,000 individuals or concerns.

In addition, the Forests yielded heavily to the public in free use. The free use of timber compared as follows with that of the previous year:

Fiscal year.	Number of permittees.	Cut.	Value.
		Board feet.	
1908	30,714	131,582,000	$168,720.00
1907	17,399	[a] 63,000,000	[a] 75,000.00

[a] Estimated.

The aggregate of free use of the Forests for grazing can not be exactly known, since no permit is required to be taken out, and there is therefore no record preserved. It added perhaps 10 per cent to the amount of stock carried by the Forests. Settlers living on or adjacent to the Forests, and prospectors, campers, and travelers in them are allowed to graze free up to 10 head of milk cows, work animals, or horses in use, and purchasers of timber and stockmen on the Forests are given the same privilege for the horses needed in their work. In Arizona and New Mexico milk goats to the number of 30 may be grazed free in place of milk cows.

Of free special-use permits there were issued during the year 1,768, as against a total of 1,471 previously granted. Of the latter 963 were in force during the year.

EXECUTIVE FORCE.

The Forests were cared for by the following executive and protective force:

	Forests under administration.	Inspectors.	Forest supervisors.	Deputy supervisors.	Forest assistants.	Planting assistants.	Rangers.	Guards.	Clerks.
July 1, 1907	169	26	96	17	46	5	647	479	27
Jan. 1, 1908	174	29	103	53	39	5	818	238	59
June 30, 1908	182	29	98	61	33	8	941	521	88

All of the National Forests except the Luquillo, in Porto Rico, were under administration at the close of the year.

The average area to each officer theoretically available for patrol duty on June 30, 1908, was 116,665 acres, as against 132,236 acres on June 30, 1907. But more than three-fourths of the time of these Forest officers is now required by the fast-growing volume of National Forest business, so that in point of fact the force on duty at the close of the year provided about one patrol officer to each 500,000 acres of Forest. This is grossly inadequate for protection of the Forests. Until provision is made for a large increase of force it is necessary either to curtail the business arising from use of the Forests or to neglect the proper safeguarding of Governemnt property against fire.

BUSINESS ORGANIZATION.

The National Forests are divided into six executive and inspection districts. Inspection is carried on from district headquarters by a corps of inspectors under six chief inspectors who report directly to the Forester; but the executive work is directed from Washington. It is superintended by the Office of Organization. Local and routine matters, however, are taken care of on the National Forests by the supervisors themselves, under the check of inspection merely, and technical matters are directed by the several technical offices in Washington. All technical questions are referred to the proper office by the Office of Organization, through which also are transmitted all instructions to supervisors originating in other offices of the Service.

Except for two minor changes, one modifying the boundary between Districts 1 and 2 to include in the former the Cave Hills, Long Pine, Short Pine, Slim Buttes, and Ekalaka National Forests, the other extending District 3 to include the new Arkansas and Ozark Forests, the six districts remained as given in last year's report.

No important change in the business organization was made during the year, but the arrangement under which a part of the office work is carried on principally by field men transferred to Washington, usually for 3-months periods, was considerably extended. In all, there were thus brought into Washington during the year 42 members of the field force. The benefits of this method in closer harmony between office and field work were marked. Another means of bringing about uniform and more efficient work by the local officers was the meetings of supervisors and rangers. Three supervisors' and 42 rangers' meetings were held in Western States. At 31 of these meetings officers from two or more Forests were present, and instruction was given by men from the Washington office concerning the regulations and their application to local conditions. Instruction was also afforded rangers through short courses in forestry, given at the Utah Agricultural College and the Colorado State Agricultural College, which added to the efficiency of the rangers who took them.

OBJECTS AND RESULTS OF ADMINISTRATION.

The purposes of National Forest administration by the Forest Service are (1) protection against fire and trespass; (2) the harvesting of timber when mature, under such limitations as the need of a reserve for future supplies of timber and the need of watershed protection impose; (3) the maintenance and betterment of a growing crop of timber; (4) the protection of the water supply; (5) utilization of the forage crop; (6) betterment of range conditions; and (7) equipment of the property with adequate means of communication and transportation and with necessary field quarters, in the interest of more effective protection and increased use.

The work of the year along these lines will be outlined under the three heads of Forest Management, Range Management, and Permanent Improvements.

FOREST MANAGEMENT.

STAND, GROWTH, AND CONSUMPTION OF NATIONAL FOREST TIMBER.—Estimates of the present stand of merchantable timber on the National

Forests obtained during the year put the total at about 390,000,000,000 board feet. The estimates were necessarily rough, since no sufficient basis exists in surveys or cruisings for accurate figures, and a liberal allowance for possible errors must be made, but the result obtained rests on far better data than have ever before been available.

Since the total lumber cut of the country reported by manufacturers for the calendar year 1907 was slightly over 40,000,000,000 board feet, the present stand on the National Forests is equivalent to a supply of lumber alone for the entire United States, at the present rate of consumption, for about ten years, or of wood material of all kinds for perhaps five or six years.

The total amount of timber cut from the National Forests during the year for all purposes, including mine timber, fuel, etc., was 524,374,000 feet board measure, or about one-eighth of 1 per cent of the estimated stand. Thus the National Forests, which embrace something like one-fourth the wooded area of the country, supplied less than 1 per cent of the wood consumed. In other words, though these Forests can never supply the entire demand of the country for wood, there is room for a vast increase over the cutting that is now being done before the annual harvests will equal the annual increase of the Forests as a whole.

Though altogether the greater part of the National Forest timber is virgin growth, fire, grazing, and such cutting as was done before Governmental control began have usually produced a forest far below the normal for the regions. In a normal virgin forest the average stand does not increase, since growth and decay offset each other, but under the present form of administration and protection the National Forests are gaining markedly in condition. The gain is most conspicuous on land severely burned over within fifty years. Much of this land is now restocking with seedling growth, which if protected from fire will soon form mature timber. The increase in growing stock which is thus being brought about will in the long run more than offset the timber now being removed.

Full utilization of the productive power of the Forests, however, does not take place until after the land has been cut over in accordance with the rules of scientific forestry. The transformation from a wild to a cultivated forest must be brought about by the ax. Hence the importance of substituting, as fast as is practicable, actual use for the mere hoarding of timber.

Since fire reports are not made by supervisors until the close of the calendar year, it is possible to give figures for losses from this cause only down to January 1. The area of merchantable forest burned over during the calendar year 1907 was 29,365 acres, and the estimated value of the timber destroyed was $31,590, as against 52,374 acres and $76,183 for the previous year. The total area of National Forest burned over was 212,850 acres, or 0.14 per cent of the entire area of the Forests on July 1, 1907. The number of separate fires reported was 1,306, of which 1,125, or over 86 per cent, were small fires, confined as a rule to an area of 5 acres or less. The entire cost of National Forest administration was equivalent to a charge of one-third of 1 per cent upon the value of the timber of merchantable size protected, allowing an average stumpage value of $2 per thousand.

The total timber cut was derived from the various States as follows:

State.	Cut under sale.	Cut under free use.	Total cut.
	M bd. ft.	*M bd. ft.*	*M bd. ft.*
Alaska	6,316	(a)	6,316
Arkansas		42	42
Arizona	36,307	3,222	39,529
California	52,395	6,640	59,035
Colorado	51,625	14,831	66,456
Idaho	33,586	44,063	77,649
Minnesota		250	250
Montana	87,543	16,748	104,291
Nebraska		6	6
Nevada	2,096	835	2,930
New Mexico	14,149	7,348	21,497
Oklahoma	8	95	103
Oregon	2,626	13,129	15,755
South Dakota	33,836	3,574	37,410
Utah	11,980	15,494	27,474
Washington	13,640	1,122	14,762
Wyoming	46,686	4,083	50,769
Total	392,792	131,482	524,274

[a] Not reported.

TIMBER SALES.—In handling timber sales on the National Forests a marked advance was made during the year. With experience the Forest officers gained greatly in efficiency.

More men of special training in technical forestry were available, and as facility in the transaction of purely routine business increased the Forest officers were able to give more attention to the broader questions of silvical treatment to insure the future productiveness and continuity of the forest.

It was found that the marking in many sales, which provided only for leaving sufficient seed trees to restock the cut-over area, would not accomplish the most satisfactory results. Where a shortage of timber for the support of local industries is to be feared, the marking system was modified so as to permit the removal only of trees which have attained their growth, or are dying or diseased. Under this method from one-third to one-half of the thriftier merchantable trees are left to make possible a second cut within fifteen or twenty years.

Since the composition and general character of the timber differ more or less in each locality, a separate set of marking rules was prepared for each of the National Forests. By following these rules the cutting on all National Forests will be brought into line with the strictly conservative policy now adopted. Lower stumps, more complete utilization, better disposal of the débris from logging, and the sale of more dead and low-grade timber marked the decided progress in timber sales on nearly every National Forest. More and better established markets were found for white fir, hemlock, aspen, fire-killed lodgepole pine, cedar, and other timbers. Sales of aspen were extended to Colorado and New Mexico, and continued in Utah.

The proper disposal of slash is insisted upon in every sale on the National Forests. In a majority of cases the principal object is to reduce both the danger of fire and the actual damage to the remaining timber should fire occur. On areas not subject to fire, and when the soil is especially barren or exposed, the tops are lopped and evenly scattered over the ground to decay, thereby fertilizing the soil and preserving moisture, both of which greatly help seed germination.

The amount of timber sold during the year was much greater than the amount cut under sales, because the larger sales are made under cts which permit the logging to cover from one to five years. lowing statement shows the amount and average price of timber sold, and the amount cut exclusive of free use, each year since the administration of the National Forests has been in the hands of the Forest Service:

	1905.	1906.	1907.	1908.
Amount sold ....board feet..	113,661,000	290,729,000	1,044,855,000	386,384,000
Average stumpage price..........................	$0.75	$1.72	$2.42	$1.90
Amount cut under sales.........board feet..	68,475,000	138,665,000	194,872,000	392,792,000

The above statement shows an excess of sales over the timber cut amounting to over 1,000,000,000 board feet. This would be the amount subject to removal under existing contracts, were it not for the fact that lapses and modifications of contracts have reduced the amount which may be cut under past sales by perhaps one-fourth.

The total receipts from timber sales each year have been as follows: 1905, $60,136.62; 1906, $245,013.49; 1907, $668,813.12; 1908, $849,027.24.

Payment for timber is always required in advance. In large sales, however, and in small sales on occasion, payment is made in installments so arranged as to protect the Government against loss without imposing unnecessarily severe burdens upon the purchaser. Thus the receipts of each year represent substantially, but not exactly, the value of the timber sold and removed during that year.

In making timber sales the Forest Service seeks small in preference to large sales, and aims to safeguard a supply for future needs rather than to swell the immediate receipts. Were it desired, the present receipts from timber sales could be quickly doubled. During the year it was found necessary in the interest of a continued supply to restrict the sales on many Forests. Nevertheless, use of the National Forests as a source of timber supply was more general than ever before.

Since a higher price per thousand is obtainable under large sales than under small, the average stumpage price obtained in 1908 shows a decline from that for 1907.

At the start large sales were necessary that lumbering operations might be begun on Forests where sales could be made in no other way. Great quantities of timber were ripe for the ax, but too remote from the market and means of transportation to be usable by small purchasers. As the country grows and transportation facilities improve, smaller individual sales become possible. Out of a total of 5,062 sales during the last year only 478 were for $100 or over, and only 18 for $5,000 or over, while requests for large sales which would have aggregated over $2,400,000 worth of timber were refused. Thus present income from the National Forests is reduced that the public welfare may be the better served in the future. The total number of sales in 1908 was greater by 236 per cent than the number in 1907, but the total amount of timber covered by these sales was but 37 per cent of that sold in 1907.

In classifying sales as large or small a sale means, of course, the total amount of timber disposed of under a single contract, not the amount covered by each cash payment made under the terms of a contract.

Before any sale of more than $100 worth of dead timber or of more than $20 worth of live timber is approved, the area is carefully mapped and examined, to determine the condition of the stand and its fitness for cutting. The value of the timber, as determined by its quality and accessibility and the current prices of manufactured products, is closely appraised, and a minimum stumpage price set. Bids are then sought through advertisement of the sale for thirty days.

The marked rise in the average price of stumpage in the years 1905–1907 shown on page 17 is partly due to the general rise in stumpage values. To some extent it is due to the fact that the Forest Service has consistently sought to secure for the Government the full value of stumpage sold. The minimum price set has often been higher than the prevailing local price of stumpage. In fixing this minimum price the Forest Service has had in view the following principles:

(1) The Government must not take advantage of local needs to exact a monopoly price.

(2) The Government must act as a trustee in the interest of the public to prevent undue depletion of a necessity of life which can not be replenished without long delay.

(3) A reasonable price for National Forest stumpage must be fixed primarily in the light of general conditions, but with due allowance for local factors. The National Forests exist not for the sake of revenue to the Government, but for the sake of the welfare of the public. The timber-sale business is managed to give stability to industry and promote the upbuilding of the country. Hence local needs are provided for, even though the stumpage price obtainable is less than might be had if the timber were sold to purchasers on a large scale. To accomplish this a minimum price is set which will not bear oppressively on local industries. The lower average stumpage price obtained in 1908 as compared with 1907 was due to the application of this principle.

Care is also taken to protect the public from monopoly prices which purchasers of National Forest timber in large quantities might be in position to charge. The fullest possible competition is secured through the advertisement of sales, but the Forest Service reserves and liberally exercises the right to refuse sales to would-be purchasers when the interest of the consumer of lumber will be better served by such action. Sales of more than $500 worth of lumber may be awarded to two or more bidders if this will tend to prevent monopoly, and several were so divided during the past year.

An important problem of the timber-sale work is raised by the relative abundance of timber in some regions and scarcity in others. In the northern Pacific States the Forests furnish a great supply of mature timber which must be cut before use can be made of the high productive power of the forest for the growing of future timber crops. But the regional supply of timber outside of the National Forests is still so great that sales could be made only at prices far below what the timber will be worth later, when it will be needed more, and at the expense of a good deal of waste in utilization. In the Southwest the present need of lumber is much more acute, and stumpage prices are higher, but because the Forests are naturally much less productive, there is need for extreme caution not to deplete the timber supply of the region to a dangerous point. For the present, sales will be made where the demand for timber requires them, but under rigid limitations to guard against overcutting in any locality.

To avoid overcutting, the approximate annual yield of each Forest has been computed. Sales are regulated in the light of this yearly increment and prospective local needs. Where the stand is limited and the local demand for domestic and noncommercial purposes is great, no sales are made; the timber is reserved for free use. Where the supply of timber is more plentiful, but needed for the support of local industries or the development of near-by communities, an amount not to exceed the annual yield of the Forest may be sold. On Forests where the annual yield allows a sufficient surplus over the amount needed locally, sales are made to supply the general market, in order that the removal of mature, defective, and dying or dead trees may open room for a new and more vigorous growth.

When rights of way and other special uses of Government land within National Forests are granted, full payment at current stumpage rates is required for all timber necessarily cut or destroyed. Careful disposal must be made of the slash as in a timber sale. During the year the total receipts from timber settlements of this character were $20,439.15.

Railroad companies seeking rights of way across the Forests are required to stipulate to clear and keep clear a sufficient strip of land to protect the timber on the Forests. The Chicago, Milwaukee and St. Paul Railway Company, of Idaho, has failed to sign such stipulation, and action for injunction will be begun against it. Since railroad companies whose rights of way were approved before the creation of the Forests are liable for timber burned through their negligence, it is believed they also will agree to sign reasonable stipulations to protect the Forests.

Timber trespass.—Timber-trespass cases reported during the past year were comparatively few. A majority were unintentional trespasses arising from ignorance of the laws, and prompt settlement was usually made as soon as the illegal character of the cutting was known. Payment has been made for nearly all of the timber cut unlawfully before the creation of the Forests. The total receipts from the settlement of timber trespasses during the year were $55,405.76.

Free use of timber.—Forest officers are authorized to grant permits without charge for $20 worth of timber during any one year to persons who may not reasonably be required to purchase. This amount may be increased in cases of great and unusual need, or to assist enterprises of a public or benevolent character. Under these regulations timber was taken from every National Forest for fuel, fencing, and building material required by settlers, for mining timbers needed in developing mineral claims, and for such community uses as the construction and maintenance of schools, churches, and bridges. More than 30,714 free-use permits were issued, as against 17,399 in 1907. About one-fourth of all the timber cut from the National Forests was under free-use permits.

The purpose of this free-use privilege is to make the Forests contribute most effectively to the public welfare. The timber given to individuals is given for the development of the country through settlement. It is not proposed to give timber to persons living on or near National Forests, even for their own use, when they may reasonably be expected to buy. As the home builder becomes established it is fair that the individual should be required to supply his private needs by purchase. On the other hand, permanent provision will be made for community needs through the setting aside of definite areas of timber to be held for free use. Settlers on National Forests under the act of June 11, 1906, will also be liberally supplied with timber for their legitimate needs, since it is to the interest of the Forests themselves, as well as for the best development of the West, that settlement within the Forests should be encouraged wherever the land is most valuable for agriculture.

Reforesting.—Reforesting of large areas of National Forests is imperative. By far the most important reason for this is the conservation of water. Denuded watersheds call for a protective forest cover in the interests of irrigation, power supply, and navigation. For the sake of timber supply, also, the present forested areas should be extended.

Reforesting is being begun both by planting and by broadcast sowing. Sowing is much more rapid and economical, but it can be practiced only under favorable soil and climatic conditions. Its use will be chiefly in the north and at high altitudes.

Experimental broadcast sowings were made during the year in 27 Forests, in the States of Idaho, Montana, Washington, Oregon, Wyoming, Colorado, Utah, and New Mexico. The total area sown was 131 acres, of which 47 were in the Black Hills National Forest.

Planting is necessarily expensive. Before it can be undertaken on a considerable scale, nurseries for growing the stock must be developed. This work is done mainly at the planting stations, of which there are now ten.

About 700,000 trees were planted last year on Forests in the States of Nebraska, Kansas, Colorado, New Mexico, Arizona, Utah, Idaho, and California. There are now growing at the planting stations over 2,200,000 trees which will be ready for planting in 1909. Sufficient seed was sown in the spring of 1908 to produce 4,600,000 seedlings.

The following statement shows the conditions of the nurseries at the end of the year:

Planting station.	Forest.	Stock on hand, seedlings and transplants.	Estimated new seedling capacity for 1909–10.
Garden City	Kansas	56,000	300,000
Halsey	Dismal River	1,510,000	500,000
Pikes Peak	Pike	375,000	500,000
Fort Bayard	Gila	318,000	500,000
Fort Stanton	Lincoln	123,000	(a)
Gallinas	Pecos	284,000	300,000
Wasatch	Salt Lake	833,000	2,000,000
Pocatello	Pocatello	226,000	500,000
Lytle Creek	Angeles	75,000	300,000
San Marcos	Santa Barbara	160,000	(a)
Small nurseries		100,000	100,000
Total		4,059,000	5,000,000

[a] To be discontinued.

The year was characterized by marked progress along the following lines: Improved nursery practice, better planting stock grown, better methods of field planting, enlarged nursery grounds, equipment, and water supply at the planting stations, and more effective organization of the work.

About 15,000 acres of National Forests have now been planted. These plantings, however, must still be regarded as experimental, since their primary purpose is to test methods and gather the knowledge necessary for successful planting on a large scale later on.

INVESTIGATIONS.—To determine the amount which may be cut annually without allowing the rate of cutting to exceed the productive capacity of the National Forests, working-plan studies and investigations were made during the year on various Forests, as follows:

A general study of the timber lands tributary to the mining camps of Cooney and Mogollon, in western New Mexico.

A preliminary estimate and working plan for the Stehekin Basin, on the Chelan division of the Washington National Forest.

A detailed study of the Manzano National Forest, in New Mexico.

There were begun:

A detailed study of the Big Wood River watershed, on the Sawtooth National Forest, to determine how much timber may be cut annually without imparing the supply required for local needs.

A detailed estimate and working plan for the San Francisco Mountains, Grand Canyon (S), and Black Mesa (N) National Forests. This is the most extensive study of the kind yet undertaken. It will furnish a detailed estimate by 40-acre tracts of the timber on these Forests, together with accurate data on the reproduction and other essential silvical conditions. The working plan, when completed, will furnish the basis for conducting future timber sales on these Forests, where well-planned, far-sighted methods of management are peculiarly needed because of the great local demand for timber and the uncertainty with which reproduction takes place.

An extensive investigation of the supply, distribution, and uses of the giant arborvitæ, or western red cedar, was made; data were collected for the preparation of a much-needed volume table for western larch; and a mill tally was begun, to show the amounts and per cents of the various grades of lumber that may be cut from different-sized trees of western yellow pine in the Southwest.

A pressing problem in National Forest management is how to secure most quickly the start of a full new crop through natural reproduction. This is, of course, a question of the best method of cutting to use under varying conditions. To answer this question studies of reproduction on cut-over areas have been begun. That of lodgepole pine reproduction in Wyoming and Colorado was completed, and a similar study of yellow pine in the Southwest is under way.

Permanent sample plots for the study of the reproduction and growth of western yellow pine were established in cooperation with the School of Forestry of Colorado College.

Studies of Douglas fir in the Rocky Mountains and of Engelmann spruce increased the information available for the management of forests in which these important timber trees occur. The results of a completed study of methods of measuring light intensity and its effect on the growth of trees, and a study of the root habits of seedlings which is under way, will benefit practical management both on National Forests and generally.

The work of locating insect-infested and killed timber, estimating its amount, and determining how to control the insects was continued, in cooperation with the Bureau of Entomology, chiefly in the Rocky Mountains. Special recommendations made by the Bureau of Entomology for the control of local outbreaks were immediately put into effect.

An exhaustive series of experiments to determine the best method of storing the seeds of the most important forest trees was begun. Plans for testing cold storage, ground storage, storage under ordinary trade conditions, and stratification were worked out and will be applied at the Forest Service planting stations, several universities, and a number of commercial nurseries and seed warehouses.

FOREST ATLAS.—The Forest Atlas contains all available data concerning the National Forests which can be graphically recorded. It is constantly changing through revisions of and additions to the sheets which compose it. During the year the map records contained in the Atlas increased to 70 volumes. The data relating to each National Forest are being rapidly reduced to the adopted standards of scale, symbols, and color schemes, and the folios thus prepared are being printed for the use of supervisors and rangers. Twenty-four folios have been printed and issued, and advance photographic copies of eight folios have been prepared. It is expected that, with the cooperation of the United States Geological Survey, folios of the remaining 132 National Forests will be compiled and issued during the next fiscal year.

RANGE MANAGEMENT.

RANGE CONDITIONS.—On June 30, 1908, the grazing regulations were in force on 164 National Forests, with a total area of about 168,000,000 acres, as against 159 Forests, with a total area of about 151,000,000 acres, one year earlier. On lands added to the National Forest area between March and June 30, 1908, no grazing fee was required.

The highly favorable range conditions which prevailed on almost all the Forests during the earlier half of the calendar year 1907 continued to the close of the last grazing season. Feed was abundant and water plentiful. In consequence the stock left the higher ranges for the winter grazing grounds in first-class condition.

In the spring of 1908 the outlook was disquieting. Water was scarce on almost all the ranges. The late winter had been very dry, and with little snowfall to bring on the early feed. Stock was rapidly falling off and owners of sheep anticipated heavy losses in the spring lambing. For a time it seemed as if the stockmen were to face a very serious state of affairs on the ranges of the entire West.

The best early feed was likely to be found on the National Forests. Earnest pleas were made that entrance upon them should be allowed as early and to as largely increased a number of stock as possible. Some owners confronted the loss of their entire herds unless relief could be given them.

Steps were taken by the Forest Service to admit stock up to the extreme limit of the carrying power of the range. Fortunately, when the situation seemed almost hopeless, storms all over the West brought enough snow and rain to guarantee the spring feed and plenty of water for lambing.

The fiscal year closed in mid-season. Taken as a whole, the general conditions at the end of June were not quite so good as they have been at the same time for the last two or three years. Nevertheless, with few exceptions, the range promises to keep the stock in good condition and fatten them for the market.

This break in the long run of good seasons served to show the value of proper range protection. On the open public lands very early in the spring the range was reported as bare and for the most part without feed, while that within the National Forests was in good condition and the owners of stock upon it had no fears as to the sufficiency of their supply for the entire season.

On thirty-two of the older National Forests the improvement in range conditions due to regulated grazing warranted an increase in the number of stock; but on thirty of the newer National Forests damage from overgrazing made it necessary to reduce the number. The increase was greater than the reductions. At the same time the general condition of the range improved.

Upon urgent request of the stockmen it was decided to approve applications for grazing permits upon seven of the National Forests for periods of five years. The object of this was to give more stability to the business and encourage better care of the range. This plan was very successful and will be extended to all the National Forests which are not overstocked and upon which the range divisions have been satisfactorily adjusted.

Grazing trespass.—During the past fiscal year 259 cases of grazing trespass were reported from 85 Forests. It is the wish of the Service to settle all trespass cases amicably, and 224 of the cases were settled by the payment of reasonable damages. Of 13 cases referred to the Department of Justice, 8 were compromised and settled before any action was taken in the courts, 3 are pending, and in 2—the Shannon and Light cases—the courts upheld the right of the Secretary of Agriculture to enforce the rules and regulations. The 30 remaining trespass cases were reported too near the close of the year to secure settlement.

The majority of the stockmen are now heartily cooperating with the Forest Service to prevent grazing trespass.

Advisory boards.—Under the plan of recognizing advisory boards mentioned in the last annual report many vexatious and complicated range disputes and questions were arranged satisfactorily to the stockmen and the Forest Service. The formation of live-stock associations brought the Forest officers in much closer touch with the stockmen. Seven new boards were recognized during the year.

The results of this cooperation between the stock associations and the Service are well illustrated in the settlement of the range dispute that for years prevented the use of a large area of excellent sheep range in the Park Range National Forest. The supervisors of the Park Range and Medicine Bow National Forests brought together the advisory boards of the Snake River Stock Growers' Association of Colorado and the Carbon County Sheep Growers' Association of Wyoming, and an agreement was entered into which admits the sheepmen of Wyoming to a certain territory in the State of Colorado and along the boundary line between the two States.

Permits.—On the 164 National Forests which were under administration March 1 grazing permits were issued as follows:

State or Territory.	Cattle, horses, and hogs.				Sheep and goats.		
	Number of permits.	Cattle.	Horses.	Hogs.	Number of permits.	Sheep.	Goats.
Arizona	1,076	158,496	8,812	403	148	350,387	31,704
California	2,529	159,473	7,684	1,442	299	371,981	12,618
Colorado	2,945	250,668	7,701	45	297	563,387	4,202
Idaho	2,111	109,123	6,993	....	727	1,796,281	450
Kansas	24	6,157	92	....	....	....	....
Montana	1,853	131,668	15,172	....	180	508,285	870
Nebraska	59	24,404	1,147	....	....	....	....
Nevada	218	31,685	2,885	....	26	106,430	....
New Mexico	1,725	96,383	6,608	99	556	827,954	75,408
Oklahoma	39	8,900	91	50	....	....	....
Oregon	1,432	119,208	7,350	37	515	932,027	705
South Dakota	463	11,507	1,562	....	....	....	....
Utah	4,196	112,997	5,643	....	1,138	899,184	....
Washington	475	20,501	1,506	....	164	306,233	235
Wyoming	705	67,977	2,757	....	242	798,770	....
Total	19,845	1,304,142	76,003	2,076	4,282	6,960,919	126,192

The average number of cattle and horses grazed under each permit was 70 head, and of sheep and goats 1,655 head. The receipts for grazing on account of the above permits are given on page 12.

The number of applicants who failed to take out their permits and pay the grazing fees was 8 per cent of the total. This is the same percentage as for the last two years. In view of the financial conditions which prevailed at the opening of the season, the fact that the percentage of delinquents remains unchanged indicates a very favorable condition of business upon the National Forest ranges.

There were issued 1,161 crossing permits, which allowed 48,924 head of cattle and horses and 2,998 head of sheep and goats to be driven across National Forests. No charge is made for these permits, and no permits are required for small bands of stock which are driven along public highways. To expedite the granting of these permits, rangers and guards are now authorized to issue them. Wherever it is known that stock will need to cross a National Forest in order to reach points of shipment or their customary ranges, regular driveways are established, and every facility is offered for crossing without delay.

Permits were issued to 69 owners or lessees of 128,585 acres of private lands within National Forests, allowing 5,577 head of cattle and horses and 14,794 head of sheep and goats to be driven through the Forests to these lands.

There were in force 956 permits allowing the inclosure of not more than 320 acres as pasture for saddle horses and other animals, or for use in gathering stock grazed upon National Forests. Under these permits there is inclosed within the Forests 175,784 acres of land, or an average of 184 acres to each pasture.

Use of State lands.—Grazing is regulated upon the State lands within the National Forests of Utah under a cooperative agreement with the State land board. This agreement has proved very satisfactory. During the past year 83 permits were issued upon orders of the State land board, allowing 1,084 head of cattle and horses and

10,301 head of sheep to be grazed within the National Forests. The State paid its portion of the administrative expense and netted a profit. By a similar agreement entered into recently with the State of South Dakota the Forest Service will manage both the grazing and timber cutting upon the State lands within the Forests.

USE OF PRIVATE LANDS.—Permits were issued to owners or lessees of 1,350,780 acres of private land, allowing 50,532 head of cattle and horses and 251,819 head of sheep and goats to graze upon the National Forests in exchange for the use of the private land. To lessen delay supervisors were given authority to act upon applications whenever the fact of ownership was known to them. This greatly lessened the work in the Washington office and was a great convenience to the public.

PROTECTION AGAINST DISEASE.—Early in 1908 the Chief of the Bureau of Animal Industry again asked for the cooperation of the Forest Service in stamping out scab and mange among the sheep and cattle of the West. Upon his request the supervisors of the National Forests in Utah, California, Colorado, Nevada, Oregon, Arizona, and New Mexico were instructed not to admit any sheep unless the inspectors of the Bureau of Animal Industry had certified that the animals were free from disease or had been dipped in accordance with the regulations of the Bureau, except for ewes about to lamb, or when weather conditions made early dipping impracticable. In these cases the work was to be done at a later date.

The State authorities of Wyoming, acting in harmony with the Federal inspectors, requested that no cattle be allowed to enter any National Forest from the counties of Weston, Fremont, Natrona, Converse, Carbon, Albany, and Laramie between March 15 and July 1, 1908, unless accompanied by a certificate showing that they were free from mange and scab or had been dipped in accordance with the requirements of the Bureau. The supervisors were instructed accordingly.

In southern California, where the Bureau of Animal Industry has been making a most determined effort to free the ranges from the Texas-fever tick, the Service has cooperated in every way with most excellent results. It is believed that within a comparatively short time the ranges in that part of California will be free from this danger.

In the enforcement of all these regulations the stockmen interested most willingly complied with every requirement, recognizing that the efforts were made for their benefit and protection.

In cooperation with the Bureau of Animal Industry owners of stock using the various National Forests were assisted to combat blackleg. Notification was given through the supervisors that any user of a National Forest could secure a supply of blackleg vaccine by applying through the supervisor of the Forest upon which his stock was grazing. The plan was immensely popular, and over 5,000 doses of vaccine matter were distributed with excellent results.

PROTECTION AGAINST WILD ANIMALS.—The policy of employing guards and rangers as hunters to exterminate predatory animals upon the National Forests was most successful. It is safe to say that the value of the stock saved in this way by the Forest officers last year was far above the total amount of grazing fees paid. During the single month of April, 1908, upon five National Forests the Forest officers are known to have killed no less than 21 grown wolves and 64 pups. Each wolf over 6 months old is estimated to cause an average loss of $1,000 a year to stockmen.

An experimental effort in cooperation with the Biological Survey was made toward ridding the ranges of the prairie dogs, which are so ruinous to the grass and forage. In March, 1908, about 75,000 acres of actual dog-infested land in the Leadville and Pikes Peak National Forests, in Colorado, where the dogs are extremely numerous, were cleaned of the pests in a very short time, at a cost for the poison of about 2 cents per acre. It is estimated that, counting the cost of labor and material, the total expenses of cleaning up an area where the dogs are well established will not exceed 5 to 8 cents per acre. The necessary men and horses for the work were very willingly furnished by the stockmen, while the Forest Service supplied the poison and one man to show its use. This work can be carried on only in the early spring and late fall, when the grass is dead and the prairie dogs are hungry. The summer season is being used to determine where and how the work will be taken up later on.

PROTECTION AGAINST POISONOUS PLANTS.—On some of the National Forests severe losses of stock have been caused by poisonous plants. A study to discover what plants cause the trouble, how the losses may be prevented, and what antidotes against the poison may be found, was undertaken in cooperation with the Bureau of Plant Industry.

Some of the poisonous plants were identified and the season of danger from them determined, but the study has not yet gone far enough to enable final conclusions to be drawn.

THE CONSTRUCTION OF DRIFT FENCES.—There were issued 358 drift-fence permits, which allowed the construction of 926 miles of fence. These fences are built when they secure a better distribution of stock upon the range or assist the Forest officers in the control of grazing. Where such fences might give exclusive use of a portion of the range to any one person, it is stipulated that the range must be open to the owners of other stock entitled to share in its use. When the stockmen occupying the range within any National Forest desire to construct a drift fence which is approved by the Forest officers, the Service furnishes all material, including wire and staples, provided the stockmen will do the necessary work. The result has been to reduce the losses of stock and secure a much more economical use of the range.

DEVELOPMENT OF WATER.—In the Southwest there are large areas of National Forests which can not be fully utilized for grazing on account of the lack of water.

To encourage the development of water in these localities the Forest Service offered to allow stockmen who would construct reservoirs either permits for an increased number of stock, or 5-year permits, or cooperation in doing the work. Special-use permits were also offered for the construction of stock-watering tanks which might be inclosed. The stockmen have not taken advantage of these offers to the extent which was expected, but in many cases material benefit was obtained through water development. It will undoubtedly be necessary for the Government to take up the work of developing an adequate water supply on many of the National Forest ranges, and the stockmen in general appear to be willing to pay a reasonable advance in the charge for grazing where this is done. The principal return, however, will be from the additional stock which the range may be made to support and in the increased wealth which it will bring to the community.

During the past year about $10,000 was spent for the development of stock water.

FORAGE AND PASTURE INVESTIGATIONS.—In cooperation with the Bureau of Plant Industry, a careful study of the natural reproduction of grasses and forage plants upon the National Forests was begun, to learn how ranges which have been damaged by overgrazing may be improved with the smallest possible reduction in use. By grazing different portions of the range alternately and giving the seed of the valuable grasses and plants an opportunity to mature, the range should gradually reseed and again produce a full forage crop. The important point is to learn just when stock must be excluded if seeding is to take place. A good beginning was made on these studies.

In connection with the forage investigations a coyote-proof pasture, containing 2,460 acres of mountain land, was fenced in the Imnaha Forest to learn whether sheep could be ranged loose without a herder and how much more stock the range would carry under this method. The fence, which is described in Forest Service Circular No. 157, turned all wild animals except grizzly bear. The loss of stock was very small, while the range supported a much larger number of animals than it would have done under herding. This experiment will be continued.

BUFFALO PASTURE.—The buffalo pasture on the Wichita National Forest, for which a special appropriation of $15,000 was made by Congress, was completed during the year. The herd of 15 American bison donated by the New York Zoological Society occupied the pasture in October, 1907. One of the herd has since died, but 2 calves have been born.

PERMANENT IMPROVEMENTS.

The permanent improvement or equipment work on the National Forests exhausted the fund of $500,000 appropriated by Congress, and much of the work for which there was urgent need could not be undertaken during the year. The estimates of needed improvements received from Forest supervisors amounted in all to over $1,100,000. The urgency of some of the projects which could not be completed within the specific appropriation made it necessary to curtail Forest expenditures in other directions to the extent of $175,000 and to add this sum to the permanent-improvement fund.

During the year construction work was completed as follows: 3,400 miles of trails, 100 miles of wagon roads, 3,200 miles of telephone lines, 550 cabins and barns, 600 miles of pasture and drift fences, 250 bridges, and 40 miles of fire lines. Telephone wire to build approximately 400 miles of additional lines was shipped to the Forests, but with the funds available before the close of the year the work of construction could not be completed. Some of this work was done on each of the Forests in the United States. Although many needed improvements could not be undertaken, the benefits of what has been accomplished are seen in the more convenient and economical manner in which the Forest officers are enabled to carry on their work and in the opening up to Forest users of territory hitherto inaccessible.

A wagon road was built in cooperation with the State of Idaho from Twin Springs to Atlanta, to which the Forest Service contributed $4,000, the State $8,000, and the citizens of Boise and Atlanta approximately $7,500. Similarly, in cooperation with counties in Idaho, wagon roads and trails were built in the Bitter Root National Forest, and the Boise River and other streams were bridged. Other cooperative projects carried out were a wagon road along the Rogue River in cooperation with Josephine County, Oreg., to which the Service contributed $5,000; a wagon road in the Weiser National Forest, in cooperation with the county and the settlers interested; fire breaks in California, in cooperation with the State and with the southern counties, to which the Service and the State each contributed $5,000, and the fruit growers a larger amount; and a wagon road on the Battlement Mesa National Forest in Colorado, in cooperation with settlers, the Service contributing one-half of the total cost of $4,500.

A branch of the Office of Engineering was opened at Ogden, Utah, with the result that much time has been gained in handling current business and technical details of the work of construction.

FEDERAL COOPERATION.

Besides administering the National Forests, the Forest Service renders, on request, expert advice and assistance to other parts of the Executive Government regarding the practice of forestry.

At the request of the Secretary of War the sale of portions of the dead and mature timber on the Fort Wingate Military Reservation in New Mexico was begun in June, 1907. During the year the timber on 1,520 acres was marked. About 10 trees to the acre were selected for cutting. The Forest after logging contains numerous even-aged patches of young trees, often very dense, and an average of two seed trees 16 inches or over in diameter per acre. It is estimated that the forest will yield a merchantable cut again in forty years.

Also, at the request of the Secretary of War, examinations were made of the woodland on the military reservations at Saunderstown, R. I., at the Picatinny Arsenal in New Jersey, and at the Rock Island Arsenal in Illinois. The purpose of these examinations was to make recommendations for as complete utilization and improvement of the timber on the reservations as practicable.

On January 22 an agreement was entered into between the Secretary of the Interior and the Secretary of Agriculture placing the management of the Forests on the Indian reservations under the charge of the Forest Service. In accordance with this agreement the Forest Service has undertaken the sale of timber and the supervision of logging; the protection of the Forests; a study to determine the best permanent use of the land; and, where these lands are more valuable under forest than for any other purpose, the preparation and application of plans for their management.

Under this agreement, the Forest Service has taken charge of logging and milling the timber on the Menominee Indian Reservation, in

Wisconsin. A sawmill, with a daily capacity of 100,000 board feet, and two small portable mills are being erected. Forty million board feet of logs, cut from wind-thrown timber on the reservation during the past winter, will be manufactured into lumber this coming year.

Indian reservations, where funds are now available, are being placed under the same system of protection as the National Forests.

GENERAL INVESTIGATIONS.

Previous to February 1, 1905, the Forest Service (then the Bureau of Forestry) was without executive duties, but was engaged in promoting throughout the United States the best use of all forests and forest products, through the collection and diffusion of information. This line of work has been prosecuted more or less effectively by the Department of Agriculture since 1876, but has of necessity taken a secondary place since control of the National Forests of the West was transferred to the Forest Service, and now receives but a small part of the total appropriation.

As a means both of collecting and of diffusing information concerning the actual practice of forestry, the Service has for the last ten years cooperated with private owners who wished to introduce forest management. The knowledge gained through the studies and experiments thus made has been of the utmost value, and indeed absolutely essential to the development of practical methods of handling woodlands conservatively under American conditions. At the same time, the examples thus set up served as object lessons to educate the public. Thus investigations and education are to a considerable degree united.

Other investigations are of such a kind that practically the only means of making their results generally useful is through the printing press. Right use of the natural source of wealth furnished by the forests of the country can be brought about only by energetic and thoroughgoing popular education. Investigations are made at public expense that they may be of use, and the Forest Service seeks every proper avenue of spreading widely the information which it gathers. That part of the work of the Service which is directed specifically to spreading knowledge as to the best use of the forests is reported upon under the topic "Diffusion of information." (See pp. 34, 35.)

In the interest of the public welfare, there is the gravest need both of investigations and of education in forestry. The two together form the only means by which enlightened use and protection of one of the most important National resources can be brought about.

APPALACHIAN AND WHITE MOUNTAIN INVESTIGATIONS.

Under the special appropriation authorizing the Secretary of Agriculture to investigate and report upon the watersheds of the Southern Appalachian and White Mountains, a careful study was made of forest, water, and land conditions in those regions. A reconnaissance survey was made to determine what lands in the two regions should be permanently forested. The results showed 23,000,000 acres in the Southern Appalachians and 2,000,000 acres in the White Mountains. On this basis, the Secretary of Agriculture recommended to the first session of the Sixtieth Congress the purchase of not more than 5,000,000 acres in the Southern Appalachians, and 600,000 acres in the

White Mountains. By the purchase of areas properly located it was believed that effective protection could be given to the forests of a large part if not all of both regions.

In connection with the determination of the land which might suitably be acquired by the Federal Government, a study was made of the relationship between the forests of the two regions and the industries which directly depend upon them, or upon the streams to which the forests give protection. It was found that the future hardwood supply of the country depends vitally upon the two regions. The water powers of the streams having their sources in these mountains were found to be of immense and widespread commercial value, while the entire amount of water received by the two regions through rain and snowfall passes to the sea through navigable channels on which the Government has already made large expenditures. The influence of the forest on the protection of these watersheds was clearly evident.

The results of the investigation have in large part been published, and the action recommended for the Federal Government was sent to Congress in a report by the Secretary of Agriculture, December 11, 1907, and published as Senate Document 91, Sixtieth Congress, first session.

SILVICULTURAL STUDIES.

Cooperative State forest studies were carried on with Kentucky, Mississippi, New Hampshire, and Illinois. The work in Kentucky, begun in the summer of 1907, was a study of the forest conditions of the State in cooperation with the State Board of Agriculture, Forestry, and Immigration. Eleven counties in the eastern part of Kentucky were examined, and a report prepared describing the character of the forests, the supply of timber, and the industries dependent upon it. Among its recommendations the report urged the appointment of a State forester and the inauguration of a fire-warden system. This study will be extended over the remaining portions of Kentucky during the ensuing year.

In Mississippi a careful study of the forest resources of the southwestern portion of the State was made in cooperation with the Mississippi Geological Survey. Recommendations were made for the conservative management and protection of private forest lands and for a State forest policy. As a result of this study a preliminary circular was issued on the "Condition of Cut-over Longleaf Pine Lands in Mississippi."

Cooperation with the New Hampshire Forestry Commission was begun in a study of the taxation of forest lands in the State, to learn how the present laws operate and through what changes the conservative cutting of timber according to forest principles might be promoted.

Cooperation was begun also with the Illinois State Laboratory of Natural History in a study of the forest conditions of a portion of Illinois. It is proposed to extend this investigation at a future date over the entire State.

Forest taxation is at present a legislative problem of first importance in many States. Advice concerning it was extensively sought from the Service, and a study of the subject was begun. It will make possible more effective responses to requests for assistance from the many State legislatures which are considering a reform in their forest-taxation laws. The legislature of Alabama was assisted in the preparation of the comprehensive forest law enacted in that State.

Experiments in nursery and planting work, begun in the fiscal year 1907, were continued in cooperation with seven State institutions and three State forest commissions. The Forest Service furnished for these experiments 30,000 hardwood seedlings and cuttings and 1,200 evergreen seedlings. New experiments were started at the North Dakota Experiment Substation at Edgeley, N. Dak., at the experimental farms of the Bureau of Plant Industry at Bellefourche, S. Dak., Dallas, Tex., and Fallon, Nev., at the Pennsylvania State College, and upon the New Jersey State Forest Reserve.

During the year applications were received from private owners for field examination and advice on the management of 31 timber tracts, in 19 States, aggregating 993,258 acres, and of 40 woodlots in 15 States, aggregating 5,318 acres. Field examinations were made of 16 timber tracts, in 13 States, aggregating 201,141 acres, and of 25 woodlots, in 15 States, aggregating 2,573 acres.

Twelve planting plans were prepared for 25,345 acres of private holdings. Among them were one for planting 14,000 of cut-over pine lands owned by an iron company in the upper peninsula of Michigan, one for securing both natural and artificial reproduction on about 3,000 acres of cut-over pine lands and fire protection on about 30,000 acres of longleaf pine timber, owned by a phosphate company in Marion County, Fla., and one for the growing of cottonwood for the production of pulp by a paper company in the Ohio Valley.

As a result of past experiments in forest management and planting, it was possible to give much advice to private owners all over the United States, through correspondence. Similar work was accomplished through publications giving practical and specific information for the benefit of farmers. Examples of such publications are a revised circular on eucalypts, of which 30,000 copies were distributed in California, Arizona, and New Mexico, and "Suggestions for Forest Planting on the Northern Prairies," which was widely distributed through North and South Dakota and western Minnesota.

Studies of the extent and importance of the white-pine blight and the chestnut blight in the East, of paper birch in New England, of second-growth yellow poplar in Virginia, and of the hickories in the central hardwood region were completed, and one of wind-breaks and their effects in the Middle West were begun.

The compilation of silvical data on North American tree species was continued with success.

INVESTIGATIONS OF FOREST PRODUCTS.

The Forest Service conducts investigations of forest products along the two lines of wood preservation and wood utilization. Some of these investigations aim primarily to promote better use of National Forest timbers; others seek results either of general application or contributing to the best use of the forests of some special region.

Two experimental treating plants equipped during the year, to be operated by the Forest Service, will make it possible to study effectively the preservative treatment of dead and live timbers from the National Forests. Other wood-preservation studies are carried on through cooperation with the owners of private plants.

The handling, seasoning, and preservative treatment of railway, mine, telephone, telegraph, and marine timbers are investigated in cooperation with timber users. Because of the direct financial benefit received by cooperating companies, they are required to bear practically all of the expenses of the experimental and commercial work. The Forest Service directs the investigations and becomes possessor of all the results, which are thereafter at the service of the public. Results of cooperative studies of wood paving, tie treatments, and marine timber treatments were published during the year.

Experiments in the treatment of pine, oak, chestnut, and hemlock mine timbers were continued in cooperation with the Philadelphia and Reading Coal and Iron Company. A commercial treating plant was constructed under plans drawn by the Forest Service. Ten portable sawmills, set up on the recommendation of the Service for the utilization of partially decayed mine timbers, at a cost of $10.000, in three months resulted in a net saving of $2,000. A plant for other experiments in the treatment of mine timbers and railroad ties is being built by the Delaware, Lackawanna and Western Railroad at Scranton, Pa., and two open-tank plants for the treatment of western timbers were built by mining companies in Idaho.

At Winnfield, La., under the direction of the Forest Service, an open-tank plant is being constructed for the treatment of pine telephone poles, cross-arms, and other timbers, with strong likelihood that the result will be to prove second-growth southern pine a suitable timber for telephone poles, piling, etc.

At Fresno and Los Angeles, Cal., in cooperation with the Forest Service, a number of electric light and power companies erected experimental open-tank plants at which several thousand western yellow pine and cedar poles were treated. Part of these poles are now in an experimental line between Los Angeles and Whittier, Cal., for a test of the relative merits of the different preservatives and methods of treatment employed.

The two Forest Service treating plants are located at Norrie, Colo., on the Holy Cross National Forest, and at Englewood, S. Dak. At the first of these sound fire-killed and other dead timbers from the Forest will be treated for a telephone company, a railway company, a tramway company, a power company, and a mining and tunnel company, each of which will deliver the timber at the plant and pay the actual cost of the treatment plus 10 per cent. At the other plant insect-killed pine from the Black Hills Forest will be treated on like conditions.

Methods of wood preservation suitable for the inexpensive treatment of small quantities of farm timbers, such as fence posts, shingles, and vineyard stakes, were studied, mainly in cooperation with State agricultural departments or experiment stations.

In cooperation with the Alabama Commissioner of Agriculture and Industries, experiments in the preservative treatment of fence posts of loblolly pine and other native species were made, and popular information was given throughout the State. Other experiments were conducted in cooperation with the agricultural experiment station of the Alabama Polytechnic Institute. These experiments gave conclusive data on the treatment of fence posts cut from native trees. Similar work was carried on in Louisiana in cooperation with the North Louisiana Experiment Station. In Maryland the preservative treatment of fence posts and sap pine shingles was studied in cooperation with the Maryland Agricultural Experiment Station, largely to devise some cheaper and less volatile substitute for creosote in the hot bath.

To handle the technical problems of wood preservation which can be carried on only in a thoroughly equipped laboratory, a section of research was created. A series of experiments to determine the effect of steam and vacuum, as commonly applied in commercial treating plants, proved that their benefits have been decidedly overrated, and that they are often wholly superfluous.

The studies of the Forest Service in wood utilization aim at reducing waste and gathering knowledge of supply and consumption of wood in the United States.

At the beginning of the year the work previously carried on in the chemical and pulp laboratories at New Haven and Boston was discontinued, to be resumed at the new Washington laboratory on its completion. In wood distillation, plans for an improved fractionating still, which will be used in field experiments in refining wood turpentine, were completed, and a preliminary field study of the suitability of Douglas fir, western larch, and western yellow pine for the production of turpentine by distillation is under way. In the wood-pulp studies there were tested by the sulphite process lodgepole pine, white fir, aspen, lowland fir, hemlock, western hemlock, Engelmann spruce, incense cedar, red spruce, scrub pine, loblolly pine, tupelo, cypress, tamarack, and Douglas fir. A few tests were also made by the soda process. So far it has been found that a merchantable pulp can be made from 15 different woods not commonly used at the present time, and that 7 of these will be of value in the unbleached state for making news paper. A method was devised for determining the depth of penetration of zinc chloride into wood. Attempts to establish a method for determining the quantity of creosote in creosoted wood obtained some good results, but the work is not yet complete. Study of the quantity of water-soluble substances leached from chestnut wood is under way.

Work in testing the strength of various kinds of timber was vigorously prosecuted. It was carried on in cooperation with Yale and Purdue universities, the University of California, and the University of Washington. The study of Douglas fir was practically completed. Shortleaf pine was proved to be in the same class with loblolly pine as a structural material, and to have about 85 per cent of the strength of Douglas fir. Western hemlock was found to be stronger than loblolly and shortleaf pine, but less strong than Douglas fir. Western larch was found to be a much better structural timber than has been supposed, with a strength very near that of longleaf pine and Douglas fir. California tan-bark oak was discovered to be suitable for use as a substitute for eastern hardwoods, while a number of species of eucalypts proved to be capable of use in place of hickory and oak.

A great variety of other tests furnished data on the strength, resistance to wear, behavior under different loads and conditions, and suitability for special uses of a number of other woods.

A study of market conditions and prices yielded material for the guidance of Forest officers, while in cooperation with the Bureau of the Census the statistical work which shows the annual consumption of forest products was brought to a much higher pitch of accuracy than ever before. Through this work the drain upon our forest resources was learned to be even greater than had before been realized. The importance of accurate statistical data as a basis for plans for forest conservation and utilization is very great.

Turpentining experiments continued the study of the relative merits of shallow and deep chipping.

Studies in the characteristics of pine resins, made in cooperation with the University of North Carolina, yielded information which make possible further improvements in turpentine production. The forest herbarium and wood collection, which aid in identifying specimens submitted for identification by commercial users of wood, teachers, and others, were added to, and new information was gathered concerning the distribution of North American trees. The willow-culture investigations led to new discoveries of value to American willow growers and manufacturers of willow ware, and 125,000 basket willow cuttings were distributed to correspondents in nearly every State.

DIFFUSION OF INFORMATION.

The knowledge gathered by the Forest Service was made practically available for the public through correspondence, publications, addresses, and the preparation of information for the use of newspapers, teachers, publishers, and others.

As a result of its scientific studies of American forests and forest products, the Service is increasingly able to give advice by letter concerning the management of woodlands, forest planting, methods of handling, seasoning, manufacturing, and utilizing woods, the extraction and manufacture of other forest products, and many similar matters. Since every investigation aims at securing results of practical value, the account already given of the investigations themselves shows in how many ways the Service is prepared to give information. A heavy and steadily growing correspondence from persons seeking advice marks the increasing demand.

To make known the fact that the Service has advice to give, however, the public must be informed of the investigations made and their practical significance. Generally speaking, the studies made by the Service concern not small groups of producers or consumers, alert to seize upon and apply every new discovery and improved method, but a great body of scattered individuals. The woodlands of the country are very largely in the hands of small owners, who have little knowledge of the practical operation of forestry and can seldom afford to employ a professional forester, and the wood and water users include, in one way or another, all classes and occupations.

The Service does not wait until men whom it might help learn by accident that it has information which would profit them. On the contrary, the Service studies how to reach as quickly and widely as possible those in whose interest its investigations are made. To do this it prepares most of its publications with special reference to the ordinary reader, reduces their cost per copy to the lowest point, and circulates them widely. But even then it can reach only a small fraction of those directly concerned. Accordingly it seeks still wider publicity for its useful knowledge through information given to newspapers and similar channels of communication. The results have proved this to be one of the most efficient means of promoting better use of the country's forest resources.

During the year 75 new publications were issued. The total distribution was 4,635,800 copies. There were also made reprints of 146 publications, of which 309,200 copies were distributed. The total distribution of 4,635,800 copies of Forest Service publications was against 2,948,000 copies in the fiscal year 1907.

The cost of editing, proof reading, and similar work of handling the voluminous printing of forms, etc., used in the work of the Service itself, of maintaining a mailing list of 670,000 names, and of addressing envelopes (including much addressing for other purposes than the distribution of publications) was $38,675.87. The editorial force varied from 5 to 7 men, but was largely occupied with other than editorial work.

There were delivered by members of the Forest Service during the year 458 public addresses. These were given, in response to requests, before gatherings of National Forest users, trade associations of wood users and similar bodies, chambers of commerce and boards of trade, meetings of farmers, educational assemblies, and the like. Only a part of the demand for such addresses could be met. In filling requests consideration is given both to the probable opportunity offered by the character and importance of the meeting and to the cost in time and money, if a speaker is supplied. Most of those assigned to deliver addresses attend the meetings at which they spoke in the course of travel undertaken, because of their official duties, etc., at relatively small expense.

At the request of authors or publishers information was supplied for the preparation of 6 text-books.

There were prepared during the year 418 statements for the use of newspapers. These were mailed, under official cover showing their source, to newspaper correspondents in Washington and to newspapers not represented in Washington in the various States and Territories. Statements prepared for magazines were collections of special information, prepared only on request. They embodied such facts as the Forest Service could give on specific subjects of inquiry, and were sent to the magazine editors or publishers. Individuals were not supplied with such statements, but official information sought concerning forestry or the work of the Service was supplied, as a matter of course, impartially to all applicants.

To learn whether information so given was actually printed by the newspapers it was mailed accompanied by an official label to secure the return of a copy of any paper using it, and a request that a copy be sent. With the aid of a standard newspaper directory the total circulation for each month was computed. The average monthly circulation known to have been obtained, reckoned in this way, was 9,600,000. The average circulation of the papers using the articles was 13,877.

WORK FOR THE ENSUING YEAR.

CHANGES IN ORGANIZATION.

The organization of the Forest Service, which continued substantially as charted in last year's report, will undergo important changes during the fiscal year 1909. Plans for a considerable rearrangement of the units of organization were prepared, to go into effect July 1, but the new scheme in its entirety will not be in force until January 1. The chart printed on page 37 shows the grouping of branches and offices proposed.

A plan for the redistricting of the National Forests was prepared, to take effect July 1, 1908. At the close of the fiscal year 119 supervisors were in charge of 188 units, comprising 171 Forests. As redistricted, 143 units, comprising a like number of Forests, will be administered by 140 supervisors. These changes made necessary the adoption of 58 new names of Forests, and more appropriate or convenient names were given to some of the existing Forests.

ESTABLISHMENT OF FIELD HEADQUARTERS.

Along with these changes will be made what is expected to prove a long step forward in National Forest administration. There will be established in each of the six existing inspection districts an executive headquarters, in charge of a district forester. The location of these headquarters and the district foresters in charge of them will be as follows:

For District 1, at Missoula, Mont., W. B. Greeley; District 2, at Denver, Colo., Smith Riley; District 3, at Albuquerque, N. Mex., A. C. Ringland; District 4, at Ogden, Utah, Clyde Leavitt; District 5, at San Francisco, Cal., F. E. Olmsted; and District 6, at Portland, Oreg., E. T. Allen.

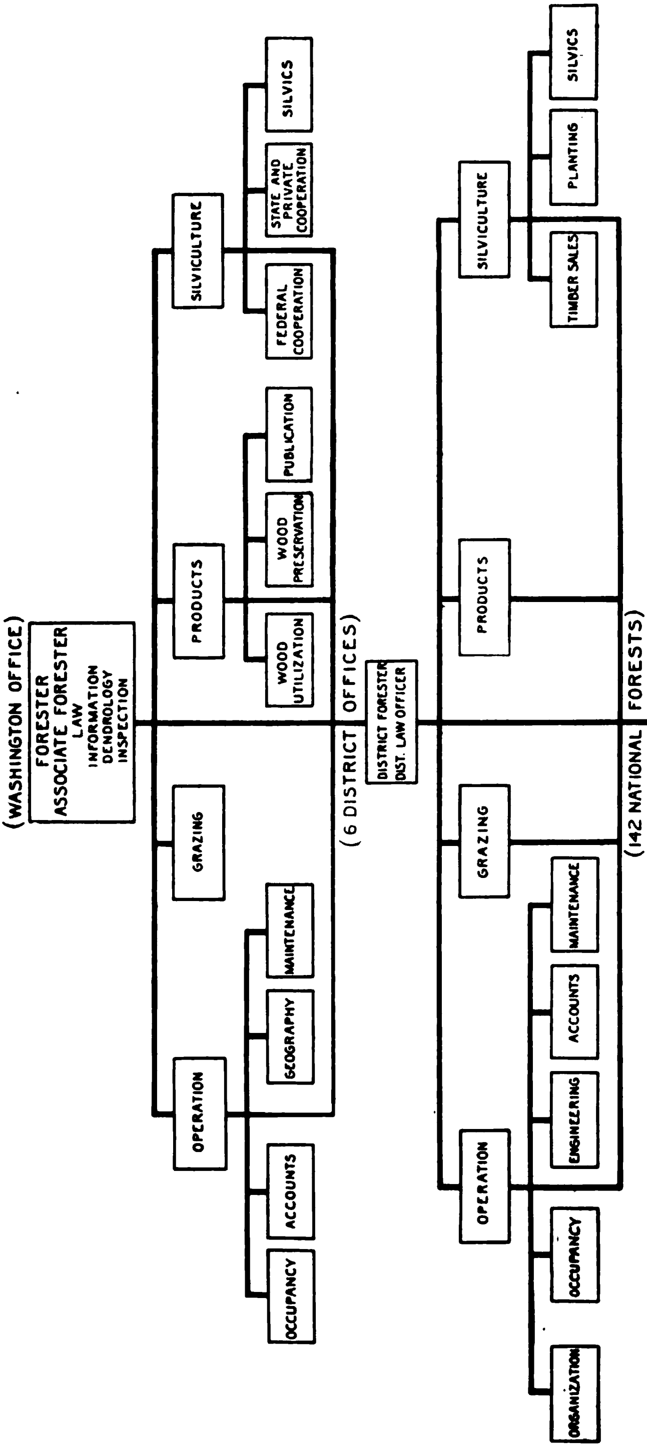
Each district forester's office will be organized under substantially the same scheme as that in force for the Forest Service, with experts of technical training and executive experience in charge of the various lines of work. The great gain that will be secured by this change will be the much closer relations between the direction of the work and its execution, which the nearness of the new headquarters to the field work will bring about, the saving of time in the transaction of business, and the better opportunity for technical oversight of the work of supervisors. Most of the officers in immediate charge of the National Forests are not men of technical training, though possessed of practical experience of the most valuable kind. With the help of the district staffs they will be able to bring their Forests to a better condition than ever before.

The bulk of the National Forest business now referred to Washington will be transacted in the districts. Only questions of large importance and matters involving the general administration and policy of the Service will be submitted to the Forester for decision. Control will be maintained through inspection by Washington officers. The force employed at Washington will be reduced more than half.

OFFICE OF THE FORESTER.

LAW.

The law officer will continue to give advice to officers of the Forest Service in legal matters, pass upon the legality of contracts, and



Organization of the Forest Service.

assist in the prosecution of offenders against the laws and regulations governing the use of the National Forests. A comparative study of the taxation of forest lands in the United States and foreign countries will be carried on during the year.

INFORMATION.

The agricultural appropriation act of 1909 provided that "no part of the appropriation shall be paid or used for the purpose of paying for in whole or in part the preparation or publishing of any newspaper or magazine article, but this shall not prevent the giving out to all persons, without discrimination, including newspaper and magazine writers and publishers, of any facts or official information of value to the public."

To ascertain whether the work of the section of information as actually carried on was in any way affected by this provision of the law, the Secretary of Agriculture asked the Attorney-General for an opinion. The opinion rendered was in part as follows:

> It is proposed to distribute such statements in typewritten form not only to the Chiefs of the Forest Service divisions stationed at Washington and by mail under frank to Inspectors and Supervisors in the field, but also to State foresters and agricultural and forestry institutions, to individuals interested in such matters, and to newspapers and magazines, including trade journals especially interested in forestry, and to writers for the newspapers and periodical press who request or are interested in the information.
>
> Your inquiry is whether the Forester may lawfully distribute information to the individuals and bodies enumerated in the manner set forth. You also ask whether "if a single newspaper or magazine writer or publisher requests an article or information for use by him in the preparation of an article, may such information be lawfully sent to the inquirer in the form of a letter?

After quoting from the Revised Statutes, section 520, and from the appropriation act of 1908, the opinion continues:

> You express the view that in distributing such information as is compiled and sent out by the Forest Service, especially to persons engaged in the practice or study of forestry, and generally to the public at large through the newspapers and magazines, you are fulfilling the primary and fundamental duty imposed upon the Department of Agriculture by the section of the Revised Statutes quoted above. Information thus given out will be accompanied by a notice that it is sent in accordance with the proviso to the appropriation act of 1908 just cited. There will therefore be no discrimination; and you say, further, that no money will be paid on this account to any newspaper or magazine or to any newspaper or magazine writer or publisher, or to any person not regularly employed in the Forest Service. Obviously, such information as has been collated and distributed heretofore and will continue to be sent out is of value to the public, and certainly your determination that it is so, as head of the Department of Agriculture, is conclusive. Under this state of facts I can see no reason to doubt that your conception of your official duty in this respect is legally correct, and that the Forester may lawfully distribute information as proposed; and I am also of the opinion that information requested by a newspaper or magazine writer or publisher may lawfully be sent in the form of a letter.
>
> Returning herewith the copies of the Forest bulletins for the month of March, 1908, I have the honor to remain,
>
> Very respectfully, CHARLES J. BONAPARTE,
> *Attorney-General.*

The work of the section of information will, in accordance with this opinion, be continued along the lines of the past. A complete file of everything given out is preserved, and is open to examination.

DENDROLOGY.

Investigations of the chemical and physical characteristics of southern and western pine resins and the physiological conditions of resin secretion will continue. Work on a series of manuals for the indentification of woods and on regional studies of tree distribution will be prosecuted. Experiments in the growing of basket willows will be carried further, and cuttings of the varieties best suited to the American grower will be distributed to promote their general introduction and culture.

A Forest Service exhibit will be prepared by the dendrologist for display at the Alaska-Yukon Exposition.

BRANCH OF OPERATION.

OCCUPANCY.

Few examinations of lands will be made looking to the creation of National Forests. Examinations for additions to and eliminations from existing Forests will also be materially less than during the present year. The selection and withdrawal from entry of administrative sites for rangers' headquarters will be continued, with the assignment of expert surveyors to supplement the work of the local officers on the National Forests.

The force of examiners of lands applied for under the act of June 11, 1906, will be largely increased, and by the close of the field season of 1908 this work will be completed on all applications received up to that time.

Because of the increasing number of claimants to lands within National Forests additional men will be assigned to the work of examining into the validity of such claims.

In the examination of large power projects which involve special-use permits, the local officers on the National Forests will be assisted by engineers detailed by the office of engineering.

GEOGRAPHY.

The examination of the records of the General Land Office for information regarding land titles within National Forests will be finished. The compilation of Forest Atlas folios for all the National Forests will also be completed, and duplicates made for the use of district foresters and supervisors, which will furnish the bases upon which later information will be posted.

Mapping and other drafting work relating to the National Forests will be done so far as practicable in the district offices, and that done in Washington will be restricted to work of a general character.

Minor blueprinting needed in the districts will be done there, but the greater part of the photographic work will continue to be carried on in Washington.

ACCOUNTS.

With the establishment of field headquarters in the six districts the accounts of each district will be handled in the district itself, the Washington office becoming virtually a seventh district, so far as its accounts are concerned. There will be a special fiscal agent in each district.

To facilitate the prompt payment of wages to laborers employed on permanent improvement work and in fighting fires, a number of the supervisors were during the past year appointed temporary special disbursing officers. During the year 1909 this plan will be extended by the appointment of additional agents, thus permitting the speedy payment of accounts for planting, brush burning, and local supplies.

A project ledger prepared for the use of supervisors will secure a complete record of the cost of each individual project of equipment work.

ENGINEERING.

The estimates submitted by the supervisors for equipment urgently needed during the ensuing year aggregated over $2,100,000. Since the appropriation provides only $600,000, most of the work covered by these estimates can not be undertaken. It will be possible to provide 650 cabins and barns, 800 miles of drift and boundary fences, 200 bridges, 175 miles of roads, 3,500 miles of trails, and 2,700 miles of telephone lines; to clean, repair, and protect 250 watering holes for stock, and to construct over 50 miles of fire lines.

Road and trail constructions will be undertaken in cooperation with counties in Idaho, Colorado, and other States, and with communities and individuals in practically all of the Western States. The construction of fire lines in California will be continued in cooperation with the State and with some of the southern counties. Drift fences will be built in cooperation with the stockmen in Colorado, Arizona, New Mexico, Utah, Idaho, and possibly other States, and a large amount of trail and bridge construction will be done in cooperation with individuals in practically all of the Western States.

OGDEN SUPPLY DEPOT.

Supplies for the National Forests and other field stations in the West will henceforth be distributed from a newly opened supply depot at Ogden, Utah. This depot was equipped during the year and placed in charge of an experienced property clerk and assistant from the Washington office, and began operating on July 1. The time required for the filling of requisitions will be very greatly reduced, as compared with shipments from Washington. Contracts for the purchase of supplies for the ensuing year call for delivery directly to the Ogden depot.

BRANCH OF SILVICULTURE.

FEDERAL COOPERATION.

At the request of the Secretary of War, the Forest Service will examine additional military reservations which contain forests of any importance, with a view to determining how much timber can safely be cut and preparing plans for their conservative management.

The work in cooperation with the Office of Indian Affairs will be continued and largely extended. As fast as funds are available, a system of fire protection will be established on each forested reservation. The logging and manufacture of the wind-thrown timber on the

Menominee Reservation will be continued by the Forest Service, and the utilization of dead and deteriorating material from other reservations will be begun as rapidly as the necessary field examinations can be made.

STATE AND PRIVATE COOPERATION.

The study of forest conditions in Illinois and Kentucky will be continued, as also will the study of the tax and fire laws in New Hampshire. The New Hampshire study will be concluded during this fiscal year. The Kentucky study will cover about half the State, including practically all of the large timber regions, and will in all probability be continued in the following year. The Illinois study is preliminary, covering only selected timber districts of the State, and will also probably be continued during the following year.

As a result of a letter from the Forester to the governors of the different States offering the cooperation of the Forest Service in a preliminary examination of their forest conditions, it is expected that many States will avail themselves of the offer, and work will be started in these States as soon as possible.

Cooperative work with the Northern Pacific Railway Company in determining the value of Government and railroad land and timber lying in the National Forests will be continued.

The number of applications for the examinations of private lands continues to increase steadily, and these examinations will be made as provided for in the agricultural appropriation bill under the head of "Forest investigations."

SILVICS.

The most important work during the year 1909 will be the establishment of a number of National Forest experiment stations. At these it will be possible to investigate throughout a long period of years the very important silvicultural problems which demand solution, and which can be answered satisfactorily in no other way. The results obtained from different methods of cutting, the influence of forests upon stream flow, and the breeding of trees are some of the problems which will be taken up.

The studies now in progress will be continued, new studies will be undertaken, and the compilation of silvical data from all available sources will carry further the organization of existing material.

In cooperation with the Weather Bureau a number of weather stations will be established on National Forests, especially at high altitudes, to secure precipitation and temperature data. The data hitherto collected by the Weather Bureau were for the most part obtained at the lower levels in the National Forest regions, and therefore can not be safely applied in drawing conclusions for the Forests. Precise knowledge of climatic conditions is important both for forest management and for water conservation.

In cooperation with the Reclamation Service and the Geological Survey, the collection or summarizing of data concerning the influence of forests in regulating streams, springs, and artesian wells, and in preventing erosion, will be begun. In cooperation with several colleges and experiment stations, investigations will be started of a number of important silvical problems; and in cooperation with a large number of voluntary observers all over the country, there will be started a systematic observation of the time of leafing, flowering, and fruiting, etc., of forest trees.

PLANTING.

If the results of the seed planting of 1908 are as favorable as indications promise, the Halsey, Pikes Peak, Fort Bayard, Gallinas, Wasatch, and Lytle Creek planting stations will be enlarged.

Careful plans for planting for the next five years on the National Forests most in need of attention will be prepared by technically trained men. Each planting station will be made a central distributing point for a group of near-by forests. Both the number of seedlings to be raised and the distribution of stock will be definitely determined so as to place nursery operations upon a thoroughly systematic basis. An expert will be placed in charge of extension work in each of the six new administrative districts. This will make it possible to study conditions and push the work more vigorously.

Extensive experimental broadcast sowing will be done on 24 forests, utilizing something over 600 pounds of seed. A much larger quantity of seed will be collected than in former years. This seed will be used both for further broadcast sowing and for the production of seedlings at the planting stations.

The planting stations will be equipped with trained men permanently assigned to them to keep pace with the growth of the work. These men will constitute a force of experienced nurserymen, who will be able to conduct the work in the most effective and economical manner.

An investigation as to what has been accomplished by private land owners as the result of planting advice given by the Forest Service will be made. Kansas hardy catalpa plantations and California eucalyptus growing will be studied. The possibilities of forest planting in the farming and fruit-growing regions of New York State will be inquired into, and additional information will be gathered as to the commercial range of a number of important species.

Miscellaneous data on planting will be compiled, and seed storage tests will be made through extensive experiments.

BRANCH OF GRAZING.

The study of improved methods of handling stock upon the ranges will continue to seek means of making the National Forest grazing lands more useful. Special attention will be given to the life history of the grasses and forage plants in order that the ranges may reseed. Experiments will be continued in fencing certain ranges and studying the effect of alternate grazing within the inclosures, as well as new methods of handling the stock. Experiments will also be continued in planting seed upon sections of the range which will be open to grazing and upon small sample areas from which stock will be excluded. The study of poisonous plants will be extended into all localities where serious losses of stock have been reported.

The work of exterminating prairie dogs upon the National Forest ranges will be continued under a systematic plan which will provide for cooperation with the stockmen in all localities where the damage from this cause is serious.

As in the past the fullest cooperation of the stockmen will be invited, and every endeavor will be made to regulate the use of the National Forests with a view to giving every possible protection to the owners of the stock grazing upon them and securing a full utilization of the forage crop.

BRANCH OF PRODUCTS.

WOOD UTILIZATION.

Both the Forest Service and the lumber trade are greatly in need of authoritative statements of the actual selling prices of the principal kinds of lumber as distinguished from list prices and quotations, which are now published by associations and trade journals. Such prices will be secured for the principal markets of the various districts.

The wood-using industries will be studied for the purpose of ascertaining more definitely the kinds and forms of timber which they require, in order that, in conjunction with the timber tests, opportunity may be afforded for developing new and more important uses for National Forest woods. One of the first problems to be taken up at the Boulder Laboratory will be to determine the strength of sound dead timber, which is found in large quantities in Colorado.

The principal work of the coming year will be as follows:

Wood chemistry.—The work in progress in analyses and wood distillation will be continued. An attempt will be made to have some of the large pulp manufacturers try upon a commercial scale the woods which have given best results in the laboratory tests, particularly white fir and Engelmann spruce. Through cooperation with the Bureau of Plant Industry, under the special appropriation for paper tests, the pulp investigations will be extended to cover fibers other than wood which gives promise of being commercially suitable for paper making.

Wood uses.—The problems now in hand will be pushed as rapidly as possible. Particular effort will be made to increase the efficiency of the studies of the markets and uses for forest products. Microscopic studies will be instituted to ascertain the manner in which wood cells break down under different influences and to determine the dimensions of pulp fibers. In order to centralize the timber-testing work and bring it into close cooperation with wood chemistry and wood preservation, the Yale and Purdue laboratories will be discontinued and a joint products laboratory established in Washington.

Turpentining studies.—Because of the additional funds made available by special appropriation, this work will be expanded to cover the following lines:

(1) A study of the timber supply to determine the extent to which turpentining under present methods has destroyed the pine forests of the South, and the probable amount of virgin timber suitable for turpentining yet remaining.

(2) A study of different methods of turpentining to determine those which are least destructive to the forest and which give the largest yields.

(3) A study to determine experimentally what methods of refining the crude product will give the most commercially acceptable grades of naval stores in the largest quantity.

(4) A study to determine how far it is practicable to produce naval stores from waste wood and thus to lessen the drain upon the forests.

(5) A statistical investigation of the annual production of naval stores in cooperation with the Bureau of the Census.

WOOD PRESERVATION.

The Indianapolis, Columbus and Southern Railroad Company will construct at Columbus, Ind., a plant to be designed by the Forest Service for the open-tank treatment of railway ties of the so-called inferior woods, to be used as substitutes for white oak.

The section of railroad and mine timbers will undertake extensive experiments with the Tennessee Coal, Iron and Railroad Company, in order to formulate a policy of timber treatments for that company, and similar work will be taken up with several coal mining companies in Illinois.

As rapidly as possible small treating plants will be constructed on the National Forests, where the conditions are such as to make the use of treated timber desirable. The section of farm timbers, while continuing present lines, will give attention to the treatment of greenhouse timbers. It will also conduct such demonstration and educational work as may be necessary to secure the adoption of preservative treatments among farmers and others who use individually small, though in the aggregate very large, quantities of timber. Statistics will be gathered on the species available for fence posts, shingles, vineyard stakes, and similar uses; the relative durability of the different species; the cost of the preservatives with which they may be treated; and the designing of plants most suitable for their treatment.

PUBLICATION.

On July 1, 1908, the office assumed charge of the entire work of distributing publications, part of which has heretofore rested in the Office of Maintenance. In addition to the popular circulars which the Service issues, a series of technical circulars and bulletins on the growth and yield of important commercial trees is projected. The office plans to enter into a much wider cooperation with teachers and officers of public instruction, and to enlarge the work of preparing educational material.

REPORT OF THE CHEMIST.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., September 14, 1908.

Sir: I have the honor to transmit herewith the annual report of the Bureau of Chemistry for the year ending June 30, 1908, together with plans for the work proposed for the year ending June 30, 1909.

Respectfully,

H. W. Wiley, *Chief of Bureau.*

Hon. James Wilson,
Secretary of Agriculture.

INTRODUCTION.

The year ending June 30, 1908, marked the completion of the first fiscal year in the enforcement of the food and drugs act and was one of unprecedented activity in the Bureau of Chemistry. Every division and laboratory of the Bureau has felt the stimulus of the new and varied demands made on the force, and often several laboratories participate in one investigation. For this reason the details of the work, condensed as much as possible, are assembled according to the various divisions and laboratories in which they were performed, as showing most clearly and concisely the organization for the enforcement of the law and the way in which the different divisions collaborate in solving the varied and numerous problems presented. It seems further advisable to call special attention to the practical application and economic importance of some other very important investigations of the Bureau of Chemistry which are not so widely known and the value of which is not so generally appreciated as is the food work, the detail of the work involved in these studies being merely recorded under the appropriate caption. Conspicuous among these studies are the paper and tanning investigations, the inspection of supplies delivered to the Government on contract, and the protection of agricultural interests from the injury of smelter fumes.

PAPER INVESTIGATIONS.

One of the duties of the Bureau of Chemistry, as provided by law, is to conduct chemical investigations for other branches of the Government, as such aid may be requested of the Secretary of Agriculture. These studies not only involve research and investigation, but also a large amount of routine work. While the subjects particularly studied are those which relate directly to agriculture, the provisions of the act establishing the Department of Agriculture make all investigations germane whose purposes relate to agriculture in the broadest interpretation of the term. It follows, therefore, that all investigations relating to the products of agriculture, their utilization, their chemical application, and their derivative products are legitimate sources of investigation in the Department. A case in point is one of the most prominent problems now submitted for solution, namely, that which relates to the paper supply of the country, closely connected as it is with the conservation of natural resources, especially the preservation of the forests, and the general economy of the public service. A vast increase in the use of paper for printing and other purposes, which has been attended with a corresponding decrease in the source of supply, has served to make the problem of paper production one of particular public importance. All of the paper-making materials heretofore utilized are agricultural products, especially those of the forest. The strength, chemical composition, and durability of the papers purchased are therefore problems which directly engage the attention of the Bureau of Chemistry because of their relations both to agricultural production and to Governmental supplies. For many years a study of the chemical composition of paper has been made a prominent feature of the work of the Bureau; associated with this, naturally, is the microscopical study of paper, without which it would sometimes be difficult, if not impossible, to ascertain the material from which the paper is made. Chemical reactions distinguish between the papers of different grades in many respects, but these reactions would not be sufficient in most cases to determine the source and character of the component fibers of the paper. Extensive advances in this field of investigation were made during the year. Not only were paper investigations made from the research point of view for the purpose of securing a more conservative use of paper-making materials and of establishing fundamental principles connected with the strength and durability of paper, but also the very large increase in the public paper supply and its control was made a feature of the year's work. The studies of samples of paper submitted for investigation by the Post-Office Department and by the Public Printer were made to this end, and a laboratory was established at Dayton, Ohio, for the purpose of inspecting paper manufactured for the use of the Post-Office Department. This was done in order to avoid delays in delivery, as it is apparent that it is far more economical and convenient to examine the supply at the point of production or before shipment rather than after it is received at the Post-Office Department. Experience had shown that shipments of paper were received at the Post-Office Department which did not comply with the specifications of the contract under which they were purchased, and when such shipments were examined by the Bureau of Chemistry and found below standard delay and annoyance were caused thereby, both to the Post-Office Department and to the manufacturer. The establishment of a laboratory at the place of production has proved of great utility to the Department and also has been advantageous to the contractor by enabling him to avoid the possibility of rejection of a shipment, and in indicating to him the proper changes in the method of manufacture necessary to secure a product which will meet the requirements of the specification.

The investigations of the Bureau show conclusively that the quality of papers of all kinds can be greatly improved and the quantity required for commercial purposes as determined by weight can be materially reduced, to the decided advantage and profit of the public. The Bureau has also found that the permanence of Government records and of other valuable documents can be more certainly insured, and the weight, bulk, and cost of all paper used by the Government can be reduced from 10 to 40 per cent without the sacrifice of any essential quality, by introducing certain changes in the specifications upon which paper is bought in the several Departments. This work, by special direction of the Secretary of Agriculture, has engaged the attention of the Bureau for several years and specifications for paper, based on these investigations, are now being drawn which will undoubtedly insure a large saving to the Government in its purchases.

TANNING MATERIALS.

Similar investigations have also been pursued in connection with the supplies of tanning materials, the principles of tanning, and the quality of the final products. The problem of the supply of tannins is almost as important as that of paper, as the supply of oak and hemlock barks, which have been the principal sources of tannins up to the present time, is rapidly decreasing. The new forests do not develop rapidly enough to supply the increasing demand, and again the conserving of natural resources without unduly checking the growth of the industry becomes a burning question. New sources of supply are therefore to be sought, as well as a more economical utilization of those already at our disposal. Only science, and fundamentally chemical research, can solve these problems. The investigations of the Bureau have shown that other parts of the tree as well as the bark contain considerable tannin, though not enough to warrant the transportation of the wood in its natural state. The roots of the tree are also remarkably rich in tannin and could be utilized to advantage if transportation were not required. These investigations have shown the wisdom of establishing tannin-extract plants in regions furnishing the raw supply and reducing the material to a viscid state before transportation. In this way all parts of the crude solid bark or wood are reduced to a small bulk and the cost of transportation to a great distance is greatly diminished.

Other sources of tannin than those usually employed have also been investigated. Special interest has been taken in some parts of the South in the palmetto roots, which contain large quantities of tanning material, and investigations by the Bureau show that they may be profitably utilized. While the growing of tannin-producing plants is evidently not within the functions of the Bureau of Chemistry, the study of the composition of these plants, especially the determination of the quantity of tanning materials therein contained, and the preparation of the best products for application to the arts are important lines of chemical investigation.

CONTROL OF GOVERNMENT CONTRACTS.

One of the most important lines of the work has been investigations made for the Isthmian Canal Commission under arrangements by which all kinds of supplies which are furnished to the Commission are submitted to the Bureau of Chemistry for examination. This work consists in the examination of mixed paints, Japan drier, lubricating oils and greases, rubber valves, putty, linseed oil, steel, iron, brass, copper, kerosene oil, signal oil, gasoline, coal tar, antimony, tallow, candles, soap, sal ammoniac, coal, oakum, cement, coke, shellac, boiler compound, varnish, graphite, pig tin, and creosote. The volume of this work has increased very rapidly during the year, and the control effected has been of immense value to the officials of the Isthmian Canal Commission in insuring supplies of high character. The contractors are aware that all materials submitted are examined by the Bureau of Chemistry, and this alone has been efficacious in raising the character of the supplies furnished. It is evident that if some such control were not instituted the authorities would be at the mercy of the contractors, who would be able to fill the orders with inferior materials with impunity. Under the present arrangement, however, it is quite impossible for this to be accomplished, and the futility of attempting it has resulted in the delivery of supplies of the highest character. If any of the supplies do not meet the conditions of purchase, the Bureau of Chemistry at once certifies this fact to the proper authorities, who use this knowledge in accepting or rejecting the materials.

Similar work, though of a more restricted character, has been accomplished by the Bureau during the year in connection with the Bureau of Printing and Engraving. Practically all of the enormous supplies of paints and dyes used by that Bureau are accepted only after an examination by the Bureau of Chemistry. This method of inspection has led to great economy in purchasing, and it has been shown that under the old methods materials were furnished at a much higher cost and often of inferior quality as compared with those now secured.

POST-OFFICE FRAUD ORDERS.

The work of the Bureau of Chemistry in cooperation with the Post-Office Department to prevent the sending of fraudulent material through the mails has been conducted for several years to the great benefit of the public. The samples submitted to the Bureau of Chemistry for examination consist chiefly of the so-called patent and proprietary remedies. When the examination and analysis made in the Bureau of Chemistry show these to be fraudulent in character they are forbidden transportation by the mails, and letters and other documents addressed to the proprietors are refused delivery. This cooperation between the two Departments has succeeded in the past few years in breaking up many of the principal centers for the dissemination of such fraudulent materials.

While some of the so-called remedies are actually injurious, many are substances in common use, and when properly administered under the supervision of a physician are valuable, but the principle on which the Post-Office Department has been utilized for the dissemination of literature connected with these remedies is one which has worked great injury upon the public. Claims of the most exaggerated character are made for simple remedies, and the accompanying advertising matter is of a nature to imbue susceptible persons with the idea that they are suffering from some disease which, being purely of an imaginative character, is easily removed by the alleged remedy. The deluded subject is convinced of the virtue of the remedy and is thus led to give a certificate for its virtues. In practically all cases the price is out of all proportion to the cost of the medicine, and the fraudulent character of the transaction is beyond question. The farming community and those not within easy reach of drug stores and medicinal aid are especially the victims of this propaganda. It is hoped that the continued cooperation of the Post-Office Department and the Bureau of Chemistry may succeed in wholly eradicating this all too prevalent system of fraud. Such cooperation by experts who have been trained by long years of study and research produces the maximum of efficiency with the minimum of cost, and has the approval of the practice in other countries, notably England, where a Government laboratory has long been established to which is referred all the work of the English Government which is of a chemical nature.

POTABLE WATERS.

As a result of far-reaching agitation in regard to the impurity of municipal water supplies and the danger of typhoid and other diseases arising therefrom, the use of bottled water has been greatly increased. It is very common now to find bottled spring water not only in hotels, restaurants, and dining cars, but also in private houses. The determination of the character of these bottled waters and the question as to whether they had been subjected to any kind of sophistication are, therefore, matters calling for investigation. Accordingly, agents were sent to the original springs from which the bottled waters are supposed to come and samples at source were secured for examination, being bottled in a manner which effectually excluded all possibility of any external contamination. The waters were carefully examined, both chemically and bacteriologically, and thus the actual handling condition of the water as regards cleanliness and freedom from sophistication was determined. These data were compared with data obtained by the examination of the bottled waters purchased in the ordinary channels of commerce. In some cases there were surprising differences in character between the natural water and the bottled water sold for consumption, and in a few instances the contamination of the water was of a character to render it decidedly objectionable for potable purposes. It was evident that often great carelessness was practiced in the handling of these waters, assuming that they were really derived from the spring assigned as their source. This contamination was chiefly of a bacteriological character, and shows either that the water was not what the description represented it to be or that the original water had been so carelessly handled as to render it unfit for drinking purposes. Obviously such waters are not legitimately entitled to enter interstate commerce. Some of the data, however, seem to indicate that the waters are contaminated after they have been received in bulk, during the bottling process in the place where they are sold.

There is a peculiar tort practised upon the public in this matter because of the common belief that bottled waters are especially pure. It is manifestly of interest to bottlers of pure spring waters as well as to consumers to be able to assure the public that any bottled waters offered to them are, in the first place, genuine waters of the spring they represent, and, secondly, that they have been so handled as to escape every kind of contamination from the time they leave the spring until they are delivered to the customer. This the present supervision and study of potable waters, with the resultant demands for correct labeling, should effect.

The examination of all of the principal lithia waters under the food and drugs act has shown that very few of them fulfill the claims made by their producers and that practically none of them contains enough lithium to produce any effect by this element as a therapeutic agent. The claims made as to the medicinal properties of a large proportion of mineral waters are very much exaggerated, and in many instances are absolutely false.

INJURY TO AGRICULTURAL INTERESTS BY SMELTER FUMES.

Another investigation in which the Bureau has been engaged and which is of great public benefit is that which relates to the injury done to vegetation and animal life by the fumes arising from smelters. It is well known that large areas of the public forest domain have been practically ruined by the fumes and other wastes from these sources. The objectionable elements in the fumes of smelters are chiefly sulphur dioxid and arsenious or arsenic oxids. The former is very destructive of forest growth and vegetation in general and the latter by falling on forage on which the cattle feed may produce poisoning. The Bureau, in cooperation with the Department of Justice, has continued this investigation during the past year, studying the extent and character of these damages, as well as methods whereby they may be avoided. It is not the purpose of this investigation in any way to restrict the activities of the smelters. The reduction of ore is a legitimate industry which should be fostered in every possible way, but the smelters should be located with a view to producing the minimum of damage to vegetation and stock, and, further, the injurious wastes should be so transformed or disposed of as to prevent injury to the surrounding agricultural interests. It is well known that by a simple chemical process the sulphur dioxid which comes from these chimneys may be converted into a commercial product, sulphuric acid; while the arsenic and arsenious oxids may also be condensed and converted into forms of chemical value.

Similar investigations are conducted on the wastes of manufacturing establishments in general which are poured into the running streams, including copper, lead, and zinc. While it may entail some expense to the owners of factories to avoid contaminating both the air and water, it is evident that such action must be taken for the benefit of the public at large.

SPECIAL FEATURES OF THE FOOD AND DRUG WORK.

The work of the Bureau of Chemistry in its more general character at the present time is directed to the control of foods and drugs offered for sale in the District of Columbia, the Territories, and the insular possessions of the United States and those entering interstate or foreign commerce. The Division of Foods and the Division of Drugs are engaged not only in the routine chemical work necessary for the administration of the law, but also in research and investigations on which the routine analyses are based.

DRUG INVESTIGATIONS.

In the researches connected with the drug work particular attention has been directed to the character of the raw materials imported into the United States from which drugs are manufactured. These investigations have shown that large quantities of the materials offered for import are unsuitable for the purpose, being adulterated with dirt, sand, sticks, and fragments of all kinds, sometimes to the extent of more than 40 per cent. Special investigations have been made of a chemical and microscopical character for the identification of crude drugs of a vegetable origin, and widespread adulterations have been revealed by these studies. A drug recognized as standard by the Pharmacopœia may be replaced by some other member of the family to which it belongs, resembling it in general character but differing from it widely in therapeutic value. This substitution robs the drug of its efficacy and negates the work of the pharmacist and physician, preventing the patient from receiving the full benefit of the prescription.

The purity of drugs in general which are intended for sale in the District of Columbia and the Territories and in interstate commerce is necessarily an object of study. In order that it may be determined whether false statements are made on the labels it is necessary that their therapeutic and pharmaceutical properties be ascertained. In order that this may be efficiently done a new branch of investigation has been established of a pharmacological character.

During the year the properties of the beverages of the "cola type" have been ascertained by chemical research and their composition determined by careful chemical analysis. These results have been of very distinct value in a practical way. The influence of such a drug as caffein, often present in medicated beverages of this kind, varies greatly with different individuals, making it desirable that the public should know the character of the stimulant they are buying.

It is generally believed that an alkaloid, like caffein, when its natural form of combination is destroyed and it is administered in a pure state, is made much more active thereby, and this should be remembered when considering the amount of caffein present in medicated beverages of this type as compared with that in coffee or tea. Moreover, a person who drinks tea or coffee is aware of the fact that he has taken into his system alkaloidal material which when used in excess may prove injurious, while the drinker of the cola beverages is wholly unaware of the nature of the drug consumed. Investigations have shown that the continued use of such beverages may be injurious and their indiscriminate use by those ignorant of their nature should be controlled. This is especially true in view of their excessive use by individuals and the rapid increase of beverages of this type varying in harmfulness.

FOOD COLORS.

Prior to the passage of the pure-food law no restriction was placed on the interstate sale of food products because of the nature of the anilin dyes used in them. It was not at all uncommon to have absolute harmlessness and purity claimed for the dyes used for this purpose, and the condition of affairs was such that after the passage of this law it became necessary to investigate the whole subject. This the Department has done, with the very valuable aid of Dr. Bernhard C. Hesse, of New York City, who has been a consultant with the Department in regard to the subject of dyes and their use in foods.

Investigation showed that many of the dyes sold as harmless were very far from being above suspicion. Those sold as being absolutely pure, specially cleaned for use in foods, were found to be sold, at times, from the same cask as dyes used for technical purposes. This condition of affairs called for some immediate action, and pending the results of the complete investigation a list of seven anilin dyes permitted to be used in foods, temporarily, was incorporated in the regulations for the enforcement of the food and drugs act by the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor, being promulgated as Food Inspection Decision 76. This list comprises red, orange, yellow, green, and blue dyes—enough shades for all the practical purposes of those having need for such colors. These dyes must be properly cleaned before they will be certified to by the Department of Agriculture as being fit for use in foodstuffs. Up to the present time a complete list of dyes sufficiently pure for certification has not been presented to the Department. There have been a number of manufacturers, or their representatives, who have interested themselves in this problem of supplying clean, harmless dyes, and that so long a time has expired—the decision having been issued July 13, 1907—without a complete list being certified, indicates that these dyes as formerly sold must have been far from suitable for the purpose.

Meanwhile, the manufacturers are restricting themselves to these seven dyes in the uncertified form and have practically ceased to use any other anilin dyes. The Department will take no action against the users of any of these seven dyes, uncertified, pending certification of the full list and the possibility of their purchase on the market. The dye users, as a whole, are apparently perfectly satisfied with the list as chosen, for there are only occasional requests for its extension.

Since the publication of Food Inspection Decision 76, vegetable dyes have become quite a prominent factor. None of the anilin dyes permitted are oil-soluble; recourse must therefore be had to oil-soluble vegetable dyes for butter colors, e. g., annatto. The vegetable dye is a trifle more expensive and has slightly less tinctorial power than some of the oil-soluble azo dyes formerly used, but this is a negligible factor compared with the danger that may arise from the use of certain coal-tar dyes.

The Bureau of Chemistry is carrying on researches in respect of anilin dyes which are claimed by their manufacturers to be harmless, having the advantage of cheapness and high tinctorial power. Many experiments are being conducted to control the chemical work described in the certificates (see Food Inspection Decision 77) accompanying dyes submitted for certification. All of this work is carefully checked, and in every way the greatest possible care is taken to insure that only the highest grade and cleanest of permitted dyes reach the consuming public.

ADMINISTRATION OF THE FOOD LAW.

The administration of the food law has been vigorously pushed. Though the inspection force of the Bureau was newly appointed at the beginning of the fiscal year, its efficiency as a whole has been extremely satisfactory. Naturally, as in all cases of this kind, some experience and training were necessary before any effective work could be done, and while some of the inspectors perhaps have not comprehended perfectly the character of their work, and have not prosecuted it in the proper spirit, the greater number have developed qualities of a high order and have displayed a most commendable industry coupled with good judgment and tact. The moral effect produced by the fact that an inspector of the Department of Agriculture is likely at any time to come into a factory has been wholly good. As a rule, the inspectors have been received with great courtesy by the manufacturers and have received full inspection privileges. This sympathetic cooperation of the manufacturers has been manifested in many other ways. One of the most gratifying results obtained during the year has been the abandonment of the position of hostility which many manufacturers up to that time held, and an assumption of hearty cooperation not only with the inspection work of the Department but also with the broadest views respecting the wholesomeness of substances added to foods. A large number of prominent manufacturers during the year entirely abandoned the use of any kind of preservatives and openly announced their adhesion to the doctrine that drugs should not be placed in foods. Although there have been no suits brought so far involving the addition of a chemical preservative to a food, the practice has been openly discredited by so many first-class manufacturers as to warrant the statement that the cause of pure food, in so far as chemical preservatives are concerned, has been firmly established. A large number of cases of violation of the food act have already been adjudicated in the courts with uniform victories for the Government.

The details of the food and drug work are so fully given under the appropriate captions that no special comment is deemed necessary. In submitting this, the first annual report made under the food and drugs act, it seems permissible to express an appreciation of the loyal and efficient services of the chiefs and members of the various laboratories and divisions, who have made every effort to meet the exigencies created by the mass of new and varied work devolving suddenly upon them. The Department of Justice and the Treasury Department have also in the most earnest, sympathetic, and effective manner cooperated in the execution of the law, which it has been the aim to enforce in the same spirit of impartiality which animates the purely scientific work. The complex problems involved and their far-reaching effects make a conservative progress along certain lines necessary; but that the interests of the consumer and the honest manufacturer are one and not antagonistic, when considered not superficially but from a broad point of view, becomes more and more apparent with the progress of the work. Only certain special interests of doubtful or obviously illegitimate character can be injured by the consistent enforcement of the law.

FOOD AND DRUG INSPECTION.

INCEPTION OF THE WORK.

At the beginning of the fiscal year, July 1, 1907, there were 26 men stationed in various parts of the country as food and drug inspectors. The appointments were made from among successful applicants who took the civil-service examination in the February preceding, and were appointed in June. Actual inspection was not begun until July 1, 1907, the intervening time being employed in instructing the men concerning various details of the work. At that time the new branch laboratories were not yet ready to examine samples, and for the first month the inspectors were engaged in the inspection of food and drug factories. Official collection of samples, as the basis of prosecution under the act, did not begin, in fact, until the first of August. Necessarily, the first samples were collected under such conditions that prosecution could not be maintained in all instances. It was found that a great many circumstances actually encountered were not included in the instructions given the inspectors, for the reason that such details were then a matter of anticipation and conjecture. These omissions were supplied in a large number of cases by subsequent collection of the necessary information, particularly in regard to evidence showing interstate transaction. A second civil-service examination was held in March, 1908, for the purpose of providing a register from which additional inspectors could be appointed in whatever number the increased work incident to the enforcement of the food and drugs act required, and the total number of inspectors has been increased to 39, their movements being directed by the Chief Inspector, W. G. Campbell, from the Washington office.

STATISTICAL STATEMENT.

The primary object of inspection work is the collection of samples of food and drugs which are suspected to be adulterated or misbranded, and which, if the analysis proves such to be the case, form the basis of a prosecution. The entire number collected during the fiscal year was approximately 13,400, consisting chiefly of samples of extracts, spices, olive and salad oil, milk, liqueurs, wines, whiskies, molasses, vinegar, rye, diabetic and gluten flours, maple and cane sirups, coffee, cheese, honey, breakfast foods, misbranded morphin and cocain preparations, and drugs labeled as cures. These samples were divided among the 16 branch laboratories engaged in the examination of interstate samples, and the food and drug divisions of the Bureau of Chemistry at Washington, to which a large number were sent. One inspector has been assigned to each of the branch laboratories, with the one exception of Portland, and at New York and Boston two inspectors are stationed. The remaining inspectors have been located at points affording the easiest supervision of interstate distribution of food and drug supplies.

The important factories throughout the country have been inspected and the principal cities and towns have all been included in inspection routes. This has required a great deal of travel, but experience has shown that large cities are undesirable points for the operation of inspectors in collecting official samples. Most of the samples have been taken from wholesale jobbing houses or from parties receiving the product directly in an interstate shipment from the manufacturer. This procedure minimizes the testimony necessary in bringing a prosecution.

Of the total number of samples analyzed and found to be adulterated, 814 were collected under such conditions that interstate delivery could be shown, and these cases were accordingly certified to the Board of Food and Drug Inspection for their recommendation. Of this number 96 cases were fully summarized after the preliminary hearing had been accorded the party from whom the sample was obtained in compliance with section 4 of the food and drugs act, and prior to their reference to the Department of Justice and the proper District Attorneys.

Information concerning 86 shipments made in violation of the law was reported by inspectors who also collected the data necessary to institute legal proceedings under section 10 of the law, which provides for the seizure of such goods for confiscation by a process of libel for condemnation. These reports include the following products in the indicated amounts, showing at the same time the number of seizures made and the amount actually condemned:

Record of seizures from July 1, 1907, to June 30, 1908, under section 10 of the food and drugs act.

Substance.	Seizures recommended.	Seizures actually made.	Substance.	Seizures recommended.	Seizures actually made.
Cider: barrels	135	135	Flour: carloads	2	2
Cider: do	10	10	Flour: sacks	2,240	2,240
Cider: halves	75	75	Flour: carloads	2	....
Cider: kegs	50	50	Canned fruit ... cases	342	342
Drugs:			Sirup and molasses:		
Danderine ... barrels	65	65	Sirup ... quarts	413	418
"Brain Food" ... bottles	....	....	Molasses ... barrels	26	18
"Madam Yale" ... dozen	83	85	Wine ... do	940	1,078
Honey: barrels	23	24	Meal ... bags	300	....
Honey: do	23	....	Beer ... barrels	50	50
Honey: cases	200	7⅛	Vinegar ... do	65	48
Honey: barrels	37	35	Stock feed ... bags	500	500
Honey: cases	10	10	Canned vegetables ... cases	988	876
Coffee: cases	35	35			
Coffee: bags	84	84			
Coffee: cases	205	210			

In addition to this, libel proceedings were requested in the case of misbranded whisky, both interstate and imported, to the amount of 625 barrels and 31,359 cases. Of this quantity 92 barrels and 6,702 cases were seized and either condemned and released under bond, or are at present awaiting adjudication.

SPECIAL INVESTIGATIONS AND INSPECTIONS.

The statistical statement gives a very inadequate idea of the inspection work necessary for the enforcement of the act, and the results actually obtained. A great many brief investigations have been made by inspectors to procure information necessary, in collaboration with the work of the chemists, to determine the adulteration of particular samples, and more extended investigations of a special nature which are concerned indirectly with the prosecutions of certain violations have also been made.

Some of these special duties have included sanitary inspection of mineral water springs throughout the Eastern and Southern States and the collection of official samples; an investigation of the coffee situation, including the quantity of imported coffee and the source of importation, with a view to suppressing the practice of indiscriminately labeling every coffee as a Mocha and Java, or a blend of both; an investigation of the polishing and coating of green coffees with certain colors, which led, in one instance, to the confiscation and destruction of 84 bags of such product coated with lead chromate; study of the fruit-canning industry to determine the quality of raw products used, whether sanitary methods of canning were used, and the agents employed either in coloring or in preserving; an investigation of stock feed, as a result of which several cases were reported for criminal prosecution and a large shipment adulterated with ground corncobs, and considerably below the standard established for protein and fat, was seized and confiscated; and investigations of the process of curing and drying cod and other fish and coloring smoked salmon.

Extensive consideration has been given to the practice of labeling distilled colored vinegar as "Pure Apple Vinegar," or "Cider Vinegar." Official samples of such products have been collected throughout the country and seizures made in those instances where goods were located in sufficiently large quantities to justify such a course.

Investigations have been instituted in regard to the manufacture and sale of spurious and imitation liqueurs which purport to be imported and are foisted upon the country as the genuine products of old and well-established grades.

In addition to the routine assignments requiring the collection of samples of misbranded whiskies, special effort was made, in compliance with the specific instructions of the Secretary of Agriculture, to locate wholesale shipments of this product manufactured from neutral spirits, but branded and sold as a straight whisky or whisky blend, in violation of the act as interpreted by the Attorney-General in Food Inspection Decision 65.

Attention has been given to the method and extent of the use of durum wheat by various mills which were able to employ this grade of wheat by bleaching and subsequently marketing it under a brand that gave no indication of the quality of wheat ground. These investigations resulted in the seizure and condemnation of a number of large interstate shipments of misbranded flour.

At the request of the Navy Department regular inspections have been made of the character of foods and drugs furnished under contract to the navy supply stores and battle ships.

In September, 1907, a force of 10 inspectors participated in a campaign against adulterated milk shipped into St. Louis from dairymen residing in Illinois; 1,500 samples were collected, of which number 100 were found to be adulterated, and accordingly were reported for prosecution.

Considerable attention has been given to the practice of overmarking packages of cheese, with the result that several official samples have been collected showing that by accurate weight the packages were from 8 to 10 per cent short of the amounts indicated.

Inspectors have investigated the methods of manufacturing gelatin, including in their report an account of the sanitary conditions of the various factories. This investigation disclosed many questionable practices, and revealed the fact that the processes of manufacturing edible gelatin, gelatin used in the arts and industries, and glue were intimately associated; that the raw materials, the methods of handling and storing, and the vessels and appliances used were the same, and that it was difficult to establish a line of demarcation in the course of preparation between these products.

CANNING INVESTIGATIONS.

TOMATO KETCHUP.—One line of experiments carried on in connection with factory inspection consisted in the manufacture of ketchup on a commercial scale to determine whether such products could be kept without the use of an added preservative. One of the leading manufacturers tendered the use of his plant, assistants, and material for this work, and these were accepted. Ketchup was made in the usual manner from sound, ripe stock and high-grade seasoning ingredients, care being used in every detail. The formula was that used regularly at the factory, and each batch consisted of 50 gallons of finished product.

One method was first to sterilize the bottles and corks and reheat the ketchup after "finishing" to the boiling point. The bottling was then done at about 205° F. Another batch was "finished" before cooking and then drawn directly from the kettle to the bottling apparatus and the filling done at about 205° F. This method of sterilizing was successful, but the objection in factory practice is the danger of burns and scalds in handling the bottles.

The second method was to give the filled bottles an after process. Trials were made with different temperatures and periods of cooking, varying from 160° F. for three hours to 220° F. for twenty minutes. Ketchup is a poor conductor of heat, and it was found that a high temperature for a short time was more effective than a low temperature for a long time. The breakage in bottles in temperatures of more than 200° F. becomes a serious consideration. The breakage at 190° F. is small, and that temperature for an hour seems to be sufficient.

Tests were also made to determine the relative efficiency of whole spices, and oil, water, and acetic-acid extracts of spices in keeping the ketchup both before and after the bottles were opened. It is known that some of the condiments used in ketchup have an antiseptic value, and this property was determined for each of the extracts named, the organisms used for testing the efficiency of the spice being those commonly found in ketchup.

Tests were made upon the effect of temperature in inducing spoilage both before and after the bottles were opened. None of the experimental ketchup spoiled before opening. When opened and placed in an incubator or a very warm room, the first evidences of spoilage occurred in a very few days; in a cool room spoilage was indicated in from ten days to three weeks, and in the refrigerator it was checked for from two weeks to more than two months. Good ketchup, like other good food products, calls for reasonable care on the part of the consumer as well as by the maker.

Seventy-eight samples of commercial ketchup were purchased and compared with the experimental goods. The microscopical examination indicated the origin of the stock plainly, whether made from sound tomatoes, trimming stock, or decayed material, and the presence of artificial color was shown by the effect produced upon the different constituents. The effect of sodium benzoate in the amounts claimed upon the label was compared with known quantities in experimental goods. In connection with these last experiments tests were made to determine the effect of sodium benzoate upon living protoplasm as seen in the filaments of Penicillium, which were greatly distorted, the character of the protoplasm being decidedly changed.

Canned Peas.—Work was continued upon canned peas, being directed especially to a study of the grading for quality. Nearly all factories grade peas for size, but an accurate method of grading for quality is of recent introduction. Peas may be graded upon the basis of their specific gravity, as the young and tender ones will float in salt water of low specific gravity (1.040) and the very hard ones will sink in a solution of a density of 1.1070, while the intermediate grade will float on the latter solution. By using tanks containing such solutions, any number of loads of peas may be graded properly.

Studies were made upon the changes in size, weight, and other physical characters which the peas in these different grades undergo in blanching and processing. Good peas undergo very little change, while the poor ones are radically affected. As soon as canners make use of this method of grading and learn the changes which the pea undergoes in the various steps in canning it will be possible to greatly improve the general quality of canned peas.

Eighty-six brands of peas upon the market were examined, and studies of the changes which result from spoilage were continued.

COOPERATIVE INVESTIGATIONS.

Besides the investigations indicated, which were conducted by the inspectors exclusively, a great deal of assistance has been given to other branches of the Bureau charged with special investigations. Under this head is the assistance rendered in conducting experiments in the sulphuring and drying of fruit in California; the drying or evaporating of apples on a commercial scale, and under commercial conditions, without the employment of sulphurous acid fumes, in New York, together with the collection in that vicinity of data and information relative to the industries of dried beans, peas, berries, etc.

Assistance has also been given to the chemists having in charge the investigation of the use of sulphur in the manufacture of sugar-cane sirup, molasses, and sugar, requiring on the part of the inspectors the collection of considerable data bearing upon this industry.

One of the inspectors was detailed to the Bureau of Animal Industry temporarily for the purpose of making certain investigations in denaturing greases.

Attention has been given to the importation of empty boxes bearing labels indicating that the products to be contained therein were various grades of foreign cheese. Inspections made of the domestic plants of such importers and the collection of samples for the purpose of prosecution have resulted in the withdrawal from the market, to a large degree, of American cheese masquerading as imported goods.

Cooperation has been given in the investigation of the question of oyster contamination in and around New York waters, and further independent work was done in connection with the various sources of oyster supplies.

A large number of factories were inspected throughout the country, and much information procured for the Division of Drugs in connection with the consideration given to various cola products.

The inspectors report from all sections of the country that as a result of the collection of samples and the legal action that followed (whether a criminal prosecution or a seizure for confiscation), and also in a great many instances where no prosecution was instituted, but merely as a result of the investigation, the character of certain products has been entirely changed within the last year, the manufacturers having either discontinued altogether the adulterations formerly employed or labeled their goods to indicate the nature of the contents in a manner entirely consistent with the provisions of the food and drugs act.

FOOD AND DRUG INSPECTION AT BRANCH LABORATORIES.

In the report for 1907 the work in the examination of imported food products at six ports (New York, Boston, Philadelphia, Chicago, New Orleans, and San Francisco) was reported. During the last fiscal year 11 new branch laboratories have been installed, all of which have been in actual operation long enough to submit a report, as shown by the following table on both imported and interstate samples. Four additional laboratories, located at Nashville, Omaha, Pittsburg, and St. Louis, are in process of installation.

Statement of food and drug samples examined in the various branch laboratories during the fiscal year ending June 30, 1908.

Laboratory.	Imported samples.				Interstate samples.			Miscellaneous samples.
	Legal.	Illegal.	Flour-inspection samples.	Total.	Legal.	Illegal.	Total.	
Boston	425	283	4,130	4,838	425	540	965	105
Buffalo	119	18	211	348	523	144	667	....
Chicago	234	80	3,277	3,591	776	201	977	....
Cincinnati[a]	8	3	64	75	78	83	111	4
Denver[a]	8	4	....	12	119	19	138	....
Detroit	40	44	....	84	146	47	193	....
Galveston	46	16	129	191	90	38	128	....
Honolulu	24	18	....	42	4	3	7	....
Kansas City	....	....	....	....	54	23	77	....
New Orleans	158	139	1,303	1,600	149	93	242	21
New York	3,310	1,502	24,463	29,275	965	239	1,204	4
Philadelphia	534	335	4,600	5,469	160	92	252	3
Portland[a]	63	22	302	387	21	51	72	17
St. Paul	53	35	283	371	222	47	269	98
San Francisco[b]	175	155	2,375	2,705	174	156	330	[c]2,129
Savannah[a]	3	4	....	7	87	60	147	....
Seattle	144	73	2,262	2,479	13	10	23	5
Total	5,453	2,731	43,399	51,474	4,006	1,796	5,808	2,886

[a] In operation about three months.

[b] About seven months' work.

[c] Sulphur experiments.

In connection with the examination of routine samples at the various laboratories on the results of which prosecution will be based, important problems are constantly arising which call for immediate solution. As before noted, the inspectors and chemists work together in the solution of these questions, which have given rise to the following special investigations at the laboratories named:

Boston.—Vanilla extract; maple sugar and cane sugar; coloring matter in foods; domestic sardines, as to kind of oil used; adulteration of cocoa products; caffetannic acid and caffein in coffee.

Chicago.—Bleaching of flour; breakfast cereals.

Galveston.—Colors used in foods, in cooperation with the Association of Official Agricultural Chemists.

New Orleans.—Determination of sulphites in molasses.

New York.—Butter coloring; added oil in paprikas; rice coatings and polishings; food colors; liquors; flavoring extracts; teas; coffees; medicinal plants and drugs.

Philadelphia.—Cocoa investigations; coloring matter in foods; nitrogen and flavoring extracts.

Portland.—Certain extracts; fusel oil in distilled liquors.

San Francisco.—Sulphuring of California fruit; samples of food products submitted to the Commissary Department, U. S. Army.

Seattle.—Japanese sake (general composition and content of salicylic acid); branding of canned salmon.

St. Paul.—Durum wheat in flour milling; bleaching of flour; cereal products; fusel oil in distilled liquors, shortening methods for determination of; oxidation of various higher alcohols constituent in fusel oil; presence or absence of furfural in natural honey as taken from comb.

A number of the laboratories have been too recently installed and are not yet equipped with a sufficient number of men to perform more than the routine work reported in the table. Others, however, have already made considerable progress along the special lines indicated, and for these a brief statement of progress is made.

BOSTON LABORATORY.

The following special investigations are in progress in the Boston laboratory under the direction of B. H. Smith:

(1) In order to determine the amount of resins and extractive matter which should be present in vanilla extract, the laboratory has prepared, or in some instances has had prepared by reputable manufacturers, nine samples of standard vanilla extract (U. S. P.) representing some five different types of beans and three different modes of manufacture, and also using in one case different percentages of alcohol in preparing the menstruum. From the "lead number" and other determinations made on these samples it is apparent that of the large number of vanilla extracts on the market but a very small percentage comply with the requirements of the Pharmacopœia, and, further, that very few commercial extracts, regardless of the kind of bean used, "contain in 100 cc the soluble matters from not less than 10 grams of the vanilla bean," as required by the standard of the Department of Agriculture. This work is being continued as time permits, and is being extended to a wider range of samples of known origin.

As opportunity has offered work on maple sugar and sirup has been done to detect adulterants, such as brown sugar and cane sugar, particularly in such samples as have been modified in ash and organic matter content to meet the chemist's usual requirements. This investigation has been confined to the quantitative ash analysis, making determinations not customarily made, such as sulphates, phosphoric acid, manganese, etc. Complete ash analyses of several samples of maple products of known origin and a few samples of brown sugar and an exhaustive examination of eight or ten commercial samples have been made. Some of the latter reported as probably pure (i. e. as conforming to the standards) appear as a result of the more detailed examination to be largely sophisticated. This work is being continued.

The identification of colors used by bakers in the preparation of cakes, pastry, etc., has been studied. From about 25 samples examined up to the present time it is plain that the colors used are chosen primarily on the grounds of cheapness and tinctorial strength. This work will also include the determination of the egg content of yellow products, as without doubt much of the color used is for the purpose of misleading the consumer on this point. Considerable work has accordingly been done on the detection of saffron, turmeric, and coal-tar colors in baked goods and macaroni.

Domestic sardines as sold in the Boston market have been examined to ascertain the kind of oil used and the truthfulness of the label. Cotton-seed oil was present in every case and the labels in general were unsatisfactory. It developed, however, that the samples taken were of last season's pack (1907) and additional samples will be taken after the new supply appears on the market.

The adulteration of cocoa products has also received attention. This work includes a study of the methods usually followed for the detection of such adulterations and of the constants of cocoa butter. Some low-priced goods are shown to be wholly fictitious, being composed largely of a glucose paste artificially colored and flavored. Others contain only shells as the cocoa constituent. Many of the penny goods, especially the so-called chocolate cigars and cigarettes, are coated with resin varnishes, and the latter are being investigated and identified when possible. A number of samples contain substitutes for cocoa butter, and these extracted fats, as well as substitutes sold as such, have been carefully examined and their constants determined.

The following investigations for the improvement of methods, indirectly connected with or suggested by the food inspection work of the laboratory, have been made:

(a) THE ESTIMATION OF CAFFETANNIC ACID AND CAFFEIN IN COFFEE.—The sources of error in the official method for caffetannic acid determination have been investigated and the method has been modified and shortened; this and a new method for caffein will be reported to the Association of Official Agricultural Chemists at its 1908 meeting.

(b) THE COLORIMETRIC ESTIMATION OF BENZALDEHYDE.—The methods used by Tolman and Chace, of the Bureau of Chemistry, have been successfully applied to determining benzaldehyde in commercial almond extracts, and the preparation of aldehyde-free alcohol has been simplified.

(c) THE DETECTION OF CARAMEL IN VANILLA EXTRACTS.—A critical study of methods and a comparison of results on a number of commercial extracts have been made.

Mr. Woodman, who conducted these investigations, has also served during the last year as referee in the Association of Official Agricultural Chemists on tea, coffee, and cocoa, and other members of the laboratory have assisted in other lines of cooperative work.

CHICAGO LABORATORY.

The report on the imported samples represents for the Chicago laboratory a full year's work, while that on domestic samples covers scarcely ten months, as the laboratory was not entirely equipped until September 15. Considerable time was devoted to an investigation of the bleaching of flour under the direction of A. L. Winton, chief of laboratory, including a study of methods for the analysis of flour and bread, and the examination of samples of unbleached flour and corresponding samples bleached either at mills by the commercial process or in the laboratory, using different amounts of the bleaching gas.

NEW YORK LABORATORY.

There has been very little opportunity at the New York laboratory for any work outside of the regular routine inspection work. However, the proper conduct of the inspection work has necessitated a certain amount of investigation. This has resulted in the publication of two articles, one entitled "A Method for the Detection of Synthetic Coloring Matter in Butter," by R. W. Cornelison, and one on "The Composition of Known Samples of Paprika, together with a Method for the Detection of Added Oil in Paprika," by R. E. Doolittle, chief of laboratory, and A. W. Ogden.

Considerable work has also been done on the methods for the detection of added polishing and coating materials used in the preparation of rice, and cooperative work has been conducted in connection with the Association of Official Agricultural Chemists on colors, liquors, flavoring extracts, teas, coffees, and medicinal plants and drugs.

A matter of considerable interest in connection with the inspection work has been the detection of the use of fluorids in the preparation of bar-le-ducs imported into this country. A recent shipment of German preserves was found to be preserved with formic acid.

A great number of samples have been vinegars, and certain investigations in connection with the analysis of this product are now under way. Miscellaneous work included the examination of about 750 samples of products for the Panama Railway Commission and resulted in the rejection of a large number of shipments of products intended for this branch of the Government. The laboratory has also analyzed 65 samples of oils, which were submitted for certification for export trade.

ST. PAUL LABORATORY.

Active work on domestic samples in the St. Paul laboratory was commenced about November 1, 1907. With the exception of a small amount of microscopical work, the time previous to that date was spent in the equipment of the laboratory and inspection of imports, an effort being made to cover inspection at the ports of both St. Paul and Minneapolis.

A special investigation of the use of durum wheat in flour milling was made under the direction of A. S. Mitchell, chief of laboratory, with the assistance of Inspector D. M. Walsh. In this connection interviews were obtained with a number of the leading millers and about 47 samples of wheat secured at the mills. The composition of these samples was ascertained as far as possible, and the varieties and their relative amounts determined. This work afforded valuable information regarding the branding of wheat flour.

A special investigation was conducted, in conjunction with the Chicago and Washington laboratories, upon the bleaching of flour. The scope of this investigation covered the prevalence of the procedure, its chemical and physical effect upon the flour, the methods for its detection, and the commercial ethics of the practice. This work necessitated a review and careful study of the methods of grading by physical examination and of practical baking contests. Fully 200 preliminary analyses and trials were necessary before satisfactory methods of examination could be adopted. The final report embodies the results of 1,018 determinations, 775 being chemical and 243 physical.

This investigation also resulted in a number of improvements in the methods of analysis of cereal products, all of which will be placed at the disposal of the referee upon official methods for cereal analysis of the Association of Official Agricultural Chemists. Incidentally, valuable information was obtained regarding wheat and germ oil and the respective iodin numbers of the same.

Research was also conducted with a view to improving and shortening the present methods for the determination of fusel oil in distilled alcoholic liquors. In this connection a study has been made of the oxidation of the various higher alcohols constituent in fusel oil, including amyl, isobutyl, and propyl alcohols and their behavior both in acid and in alkaline media. It is hoped that this work will afford a method by which the oxidation can be performed with speed and thoroughness, effecting a saving of eight hours in time over the usual process and insuring greater reliability in the results. A minor investigation regarding the presence of furfural in natural honey as taken from the comb was also made.

All requests for analysis of food products made by the United States Army Quartermaster, Division of North Dakota, at Fort Snelling, and by the Treasury Department at Minneapolis and St. Paul have met with prompt compliance.

IMPORTANT FOOD INVESTIGATIONS.

Much of the time of the chief of the Division of Foods, W. D. Bigelow, has been consumed with the organization of 15 new branch laboratories, 11 of which were fully installed, with the routine administrative work of the Bureau, and with correspondence concerning the enforcement of the food and drugs act. In addition to the samples included in the report of the Washington food inspection laboratory, in this division, 2,577 samples of a miscellaneous nature were examined. Some of the more important special investigations made, bearing for the most part on problems connected with the administration of the food law, are summarized briefly.

OYSTERS.

A careful study has been made of the composition of oysters with a view to determining the treatment they have received before entering the market. A number of beds in the vicinity of New York were studied and samples of oysters taken from them subjected to the ordinary commercial treatment and modifications thereof. It was found that some dealers and shippers not only subject the oysters to excessive washing, but also add water to them, either directly or in the form of ice. The natural oyster without washing exudes over 30 per cent of liquor, sometimes more than 40 per cent, whereas the washed oyster exudes almost always less than 25 per cent. The unwashed oyster contained more than 18 per cent of solids and less than 0.5 per cent of sodium chlorid, whereas the washed oyster was found to contain less than 16 per cent of solids and less than 0.25 per cent of sodium chlorid.

The beds examined were limited to the vicinity of New York and additional data from other localities should be secured before generalizations can be made. Judging from the data secured, however, a can or package of oysters containing more than 30 per cent of liquor has either received added water or has not been washed or treated with water in any way. If it contains more than 30 per cent of liquor and at the same time less than 18 per cent of solids, or 0.5 per cent of sodium chlorid, it has apparently received an addition of water, either directly or in the form of ice. Considering the superiority of those oysters which have been washed for as short a time as possible and to which neither water nor ice has been added, the desirability of shipping in receptacles in which the ice is not brought in immediate contact with the oysters is at once apparent. These figures, however, must be modified in the case of fresh water oysters.

LEMON OIL.

For about six months the assistant chief of division, E. M. Chace, was detailed to investigate the lemon-oil industry in Sicily, and the entire time of two analysts under his direction is given to the examination of samples so secured. This investigation was called for by difficulties arising in the inspection of imported lemon oils, claims being made regarding the nature of the products which could not be otherwise substantiated.

COMPOSITION OF FRUITS.

Studies relating to the composition of fruit and the changes which take place during ripening have been continued. Studies on the ripening of plums and the identification of the acids in fruits have also been undertaken. In collaboration with the pomologist in charge of Field Investigations in Pomology, Bureau of Plant Industry, a careful study has been made of the composition of California peaches, plums, and pears in connection with pre-cooling and shipping experiments.

In collaboration with the office just mentioned and with the agricultural explorer in charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, further study was given to a method of ripening persimmons, the process used consisting in exposing the fruit to fumes of alcohol in closed wooden tubs, the natural astringency disappearing while the fruit remains firm.

The study of the preservation of unfermented apple juice has been continued. This work has not been confined to small packages, but has included experiments with samples preserved in glass, tin, and wood, and the preservation of apple juice in barrels was found to be practicable. The packages were opened from time to time and organoleptic tests made.

DISTILLED SPIRITS.

During the year an extensive investigation as to the manufacture and methods of handling distilled spirits was begun, the chief of the Washington food-inspection laboratory visiting most of the large distilleries in this country and making a detailed study of these points. In order to determine the effect of various methods of maturing the spirits, an experimental warehouse has been established in Louisville, Ky., and 60 barrels of whisky have been set aside by various distillers in this country for the experiment. These spirits are kept under different conditions of heat and moisture and samples will be taken year by year to determine the effects of the various methods of treatment.

A study has also been begun on the methods of analysis of distilled spirits, with the result that several improvements have already been made. Special attention has been given to the methods for the determination of fusel oil, with the result that a modification of the present method has been effected, which greatly reduces the time necessary for the determination and gives a much more satisfactory result.

To determine the composition of American whiskies, samples from most of the principal distilleries in this country have been obtained and most of them examined.

ANALYTICAL METHODS AND CHECKING OF INSPECTION SAMPLES.

Much attention has been given to the study of analytical methods for the judgment of the nutritive value and purity of food, and progress has been made in the quantitative determination of salicylic acid and benzoic acid and the determination of tin and other heavy metals in food products.

The Washington food-inspection laboratory, of the Division of Foods, established July 1, 1907, under L. M. Tolman, chief, has for its special work the checking of analytical work of the branch food inspection laboratories, both as to methods and as to results of analyses, and the examination of food-inspection samples taken in the vicinity of Washington under the food and drugs act of June 30, 1906. During the year ending July 1, 1908, considerable work was done in checking the various methods employed at the other inspection laboratories, every effort being made to ensure uniform practices in making analyses and reporting results.

During the year 2,706 samples of imported goods taken at the various port laboratories were reexamined in this laboratory. The total number of domestic samples examined, including 432 samples of distilled spirits and interstate and miscellaneous samples, amounts to 1,562. In addition, all of the interstate samples which are found in the branch laboratories to be adulterated and upon which it is decided to bring prosecution are checked in this laboratory before the final transmission of the cases to the United States Attorney.

A large part of the work of this laboratory consists in preparing cases for the consideration of the Board of Food and Drug Inspection, all of the analytical cards on food samples from the branch laboratories passing through the Washington food-inspection laboratory for examination and the preliminary recommendation of cases for prosecution.

DRUG INSPECTION AND CORRELATED STUDIES.

On January, 1908, the Drug Laboratory was reorganized as the Division of Drugs, L. F. Kebler continuing in charge of the work. The investigations concerned chiefly the composition, purity, adulteration, and misbranding of drugs and chemicals as found on the American markets and shipped in interstate commerce in violation of the food and drugs act. This required a study of the methods of analysis and the correctness of the standards at present official for certain drug products, and investigations of normal products with a view to establishing standards and supplying necessary data upon which to base action.

The collaborative work conducted during the past few years in connection with the United States Pharmacopœia products was continued. Special investigations were also instituted relative to certain medicated soft drinks and the character of ginger and ginger compounds. The keeping qualities of hydrogen peroxid were investigated and a study of the deterioration of certain plant products and preparations derived from the same was also continued. Considerable work was done relative to establishing quantitative and qualitative methods for estimating the constituents present in headache mixtures and other preparations containing habit-forming drugs such as acetanilid, antiphyrin, acetphenitidin or phenacetin, morphin, etc.

During the fiscal year ending June 30, 1908, there were examined in this division 1,787 samples. Of this number 482 were chemical reagents; 568 were imported products; 363 domestic samples; 35 samples of hops, tested for the presence of arsenic; 80 samples of medicated soft drinks; 32 samples of prescription schemes; 29 specimens of "loco" plant products, tested for barium content; and miscellaneous samples covering a wide variety of drugs and miscellaneous drug products, such as rat and roach paste, examined for the Biological Survey of the Department of Agriculture; castor oil pills, and peppermint oil to determine the quality of the oils produced from peppermint plants grown in various sections of the United States.

CHEMICAL REAGENTS.

The chemicals examined were those regularly supplied to the Bureau of Chemistry on contract and requisition to be used in analytical work. All chemical reagents are examined in the Division of Drugs, and supplies sent to the branch laboratories only after they have been analyzed. A marked improvement in quality has been noted, as compared with those delivered five years ago, when the systematic examination of these chemicals was begun. Manufacturers of chemical reagents have manifested a commendable willingness to supply these agents of the quality specified. In a number of cases the chemicals examined during the year were of a very inferior quality, being contaminated with dirt, insoluble matter, and impurities, which were detrimental to the ultimate success of analytical work. In the past it was common to receive a mixture of uranium and sodium acetate when uranium acetate was ordered, but this adulteration was not found during the last year.

DOMESTIC DRUGS—OFFICIAL AND UNOFFICIAL SAMPLES.

By "official samples" of drug products are meant those which have been collected in accordance with the regulations prescribed under the food and drugs act; those designated as "unofficial" are samples collected for information and study, the data obtained forming a basis for future action.

The Division of Drugs indexed during the last year 1,714 domestic drug products, of which number 1,525 were official and 189 unofficial; 363 official and 105 unofficial samples have been analyzed. Of the official samples analyzed 40 were found to be either adulterated or misbranded, in the meaning of the food and drugs act; cases based upon four of these have been adjudicated in the courts, the fines imposed varying from $10 to $700, the cases dealing with the following products: "Cuforhedake, Brain Food," "Sartoin Skin Food," "Liquid Sulphur," and the illegal sale of cocain in the District of Columbia. The remaining cases have been certified for prosecution and are either in the hands of the proper United States District Attorneys or are ready to be forwarded to the Attorney-General of the United States for action. A number of drug products were also seized in libel proceedings for condemnation, it being found that they were either adulterated or misbranded in the meaning of the law, and these cases are still pending in the courts.

IMPORTED DRUGS.

The examination of 568 samples of imported drug products included chemical analyses, verification of the results reported by the various branch laboratories, and examination of samples submitted by different laboratories of which no analyses had been made. In many cases it was also necessary to investigate the nature of the claims and representations made for certain products.

Many adulterated and misbranded products were consigned for importation. Some of the typical forms of adulterations found were as follows:

(1) Ground dandelion root adulterated with from 20 to 40 per cent of sand and small pebbles having an appearance and color approximating the color and size of the ground drug.

(2) Powdered licorice root adulterated with fine sand to the extent of 25 per cent.

(3) A number of importations marked "Sarsaparilla root" were found on examination to consist of the rhizomes, the roots having been removed and the rhizomes repacked and shipped to the United States. The Pharmacopœia distinctly directs that these rhizomes be eliminated before the product is used in the manufacture of medicinal agents.

(4) Asafetida containing from 9 to less than 50 per cent of alcohol-soluble material was frequently offered, and in a number of cases the

article containing the higher per cent of alcohol-soluble material was allowed to enter without prejudice to future decisions. The organic matter present in these asafetidas amounted to as much as 80 per cent in some cases.

(5) Belladonna root highly adulterated with pokeroot was a common article offered for importation. As a rule, the content of alkaloid was low in proportion to the degree of adulteration.

(6) Calendula flowers colored with saffron were offered on several occasions under the name of "feminelle." These importations of feminelle were brought in separately because it was well known that saffron adulterated with this product could not enter, although the object of their importation was to adulterate saffron after the article had passed the custom-house.

(7) In many cases the labels on the package or the circular accompanying the importations contained false or misleading statements. Conspicuous among these was Haarlem oil, the circulars accompanying these importations in the past containing misrepresentations of the worst character. The old circulars have, however, been largely discarded and modified statements are now made. Other preparations of the "cure" type containing false and misleading statements were forbidden entry because of the unwarranted claims.

In some cases when it is found that drug products are adulterated an attempt is made to secure permission to relabel, and one of the common expedients resorted to is to ask the privilege of relabeling "for technical use," the object being solely to secure the entry of the consignment that the dealer may dispose of it as he sees fit. It should be stated, however, that as a rule the leading importers have made every possible effort and shown every desire to import goods of a high quality, conforming with the provisions of the food and drugs act.

MEDICATED SOFT DRINKS.

Approximately, 80 samples of these products have been examined. The investigation was undertaken for the purpose of ascertaining the nature and character of the beverages sold principally at soda fountains, and special attention was given to the detection and estimation of caffein, cocain, and coloring matter. A complete analysis has been made in every case, not only to determine the composition of the product, but also to ascertain whether the ingredients claimed to be present were actually used in preparing the drinks. With few exceptions, all contain caffein added as such. In fact, the caffein is rarely introduced by using an extract of the plant or article containing the caffein in natural combination. Cocain was also found to be present in a large number, and many were artificially colored with coal-tar dyes and agents derived from vegetable and animal sources. The caffein present in an ounce of medicated soft-drink sirups, the quantity usually entering into a glass of the drink, varied from a trace to 1.2 grains. A considerable number of the medicated soft drinks were free from cocain; and when its presence was established the amount varied from a trace to 0.05 grain to the ounce, the average amount used in preparing a glass of the beverage. Fifty-four cups of tea and coffee, as served at representative hotels, cafés, and restaurants of Washington, were collected and analyzed for the purpose of ascertaining the quantity of caffein present and comparing it with the amounts contained in the medicated soft drinks. The average amount of caffein per cup of coffee was 2.2 grains, varying from 1.55 grains to 3.74 grains. The average content of caffein per cup of tea was 0.98 grain, varying from 0.31 grain to 2.15 grains. An interesting point brought out is that the tea and coffee served at the better-class hotels as a rule contain the greater per cent of caffein.

TINCTURE AND ESSENCE OF GINGER.

When this investigation was instituted there were not sufficient data available to indicate what constitutes a normal tincture of ginger, neither was it possible to determine from analysis the amount of active material that should be present in an essence made in accordance with the standards promulgated in Circular 19 of the Office of the Secretary. It was therefore decided to purchase a considerable number of representative tinctures of ginger and to manufacture several from the various gingers known in commerce, using various strengths of alcohol. These gingers were carefully analyzed to determine their physical and chemical constants for future use. It was found that the tinctures of ginger as supplied by the best manufacturers were fairly uniform in composition and agreed closely with those manufactured in the Division of Drugs in accordance with the directions prescribed by the United States Pharmacopœia, but, on the other hand, the majority of the essences usually supplied were of an inferior quality, and did not correspond with the standard promulgated.

In the past it has been a very common practice to use capsicum to fortify ginger products, and an investigation was made to determine whether it is possible to detect capsicum under such conditions. A considerable number of authentic specimens of different varieties were collected and studied, with the result that a method has been solved which appears to give satisfactory results for the detection of this adulterant.

GLYCERIN.

Fourteen samples of glycerin were examined during the year, constituting a continuation of the work begun during the preceding fiscal year for the purpose of determining whether or not the goods supplied on the market are contaminated with arsenic or other objectionable agents, and also whether or not the United States Pharmacopœia standard, Eighth Revision, was satisfactory. It was found that the glycerins supplied were of a good grade, but very few were found to comply in every detail with the Pharmacopœia standard. Several contained traces of arsenic, and the presence of foreign odoriferous products was established in the case of a large majority of the samples tested.

HOPS.

Thirty-five samples of hops were examined at the request of the Bureau of Plant Industry for the purpose of ascertaining to what extent they were contaminated with arsenic and whether such contamination is sufficient to render them unfit for use in the preparation of food products. The amounts of arsenic found in the samples submitted vary from a trace to 2,500 parts per million.

HYDROGEN PEROXID.

A study of hydrogen was undertaken primarily for the purpose of ascertaining whether or not a deterioration or marked loss takes place on standing, and, if so, to what extent. The conditions were such as would ordinarily obtain, or should obtain, in the average drug store, and the 91 samples used have been under observation for nine months, the intention being to hold them one year. It was found that most of the brands of hydrogen peroxid supplied contained acetanilid. This chemical is added with the belief that it inhibits the deterioration of the product. While the investigation is not as yet complete, the results at this time indicate that the changes on standing are not very rapid and it is doubtful if the presence of acetanilid materially retards such deterioration.

"LOCO" PLANTS.

Twenty-nine samples of "loco" plants were examined at the request of the Bureau of Plant Industry for the purpose of ascertaining whether barium were present, and, if so, to what extent, the object of the investigation being to determine the cause of the disease known to stock raisers as "loco." The barium content of the ash of the samples examined varied from nothing to 0.134 per cent.

PRESCRIPTION SCHEMES.

Since the passage of the food and drugs act there has been placed on the market a line of preparations the advertisements of which embody a prescription; that is, in the advertisement will be found a prescription which contains several well-known remedies, together with a product under a coined name, and in order to secure the remedy it is necessary for the patient to purchase a certain amount of this product. For the purpose of securing some data relative to the medicinal value of these drugs it was decided to make an investigation and compare the actual virtues of the remedies with those claimed for them by their promoters. The patient is frequently led to infer from the advertiser's claims that the products sold under coined names are new to the pharmaceutical and medical professions. Examination, however, invariably reveals the fact that the product exploited is nothing but a well-known drug or a mixture of well-known drugs, and the claims made relative to the virtues of the supposedly new remedy are, as a rule, exaggerated and misleading. In many cases it is stated that the remedy is a panacea for consumption, when, as a matter of fact, the medicine does not contain any agent or combination of agents which could be looked upon as possessing any curative properties for tuberculosis. Such remedies are plainly fraudulent and harmful in that the purchaser is led to use them and thus lose valuable time which could be employed to advantage by resorting to the open-air and proper-diet treatment in combating this disease.

COUNCIL OF PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION.

The work in cooperation with the council has been continued during the last fiscal year, and while only a limited amount of time could be given to it, several investigations were made, the results of which were published in the Journal of the American Medical Association, under the general heading of Pharmacology, and a number of frauds were exposed. Several preparations advertised to possess marvelous digestive properties due to the presence of special enzyms were found to be practically devoid of any action whatever. Another preparation claimed the presence of a bile acid which an examination failed to reveal.

COOPERATION WITH POST-OFFICE DEPARTMENT.

During the year the Division of Drugs made analyses of five medical "cures" sent through the mails and submitted by the Post-Office Department. This investigation required not only the analyses of the agents used in the treatment of the disease, but also an inquiry into the nature and truthfulness of the representations, claims, and promises accompanying the remedies. In most cases the treatment included several agents, and as many as seven have been examined constituting one treatment. These examinations during the past year consisted of consumption cures, tobacco habit cures, and epilepsy cures. In most cases these remedies consisted of mixtures of ordinary medical agents which are useful but can not in any case be considered as cures for the disease specified.

CHEMICAL STUDIES OF SUGAR-BEARING PLANTS.

The total number of samples analyzed in the Sugar Laboratory during the last fiscal year was 1,284. Samples analyzed in the field by members of this laboratory engaged in the sweet-corn investigations are not included.

The distribution of work upon these samples, indicating the scope of the laboratory, was as follows:

Cereal products (barley, malt, etc.) for Vegetable Physiological Laboratory	157
Sirups (soda fountain) for Drug Laboratory	137
Malt extracts for same laboratory	7
Wines and brandies for same laboratory	6
Honey for complete analysis (honey investigation)	26
Honey collected in execution of food law	11
Molasses collected in execution of food law	13
Other samples of molasses and sugars	30
Maple sirup collected in execution of food law	34
Miscellaneous sirups (cane, glucose, etc.)	14
Sugar beets	285
Sugar cane and sorghum	11
Liquors from cans of peas	84
Miscellaneous products (potatoes, watermelons, cantaloupes, corn, and cornstalks)	25
Cane molasses and sirup for sulphur dioxid determination in New Orleans, La	408
Dextrins, starches, and glucose for the Bureau of Engraving and Printing	27
Miscellaneous	9
Total	1,284

The main lines of investigation conducted in the Sugar Laboratory by A. H. Bryan, in charge, are as follows:

(1) Effect of environment upon the sugar content of Indian sweet corn (under the supervision of the Chief of the Bureau).

(2) Referee work upon methods of sugar analysis, Association of Official Agricultural Chemists.

(3) Study of methods for the detection of adulteration in honey.

(4) Investigations of various raw materials for use in alcohol production (corncobs, stalks, and shucks; watermelons, cantaloupes, molasses).

(5) Investigation of commercial malt and diastatic preparations.

(6) Investigations of methods of analysis for maple products and their valuation.

(7) Investigations into the sulphur-dioxid content of Louisiana cane molasses and sirup. This work was done in collaboration with the Division of Foods.

(8) Investigations of the sugar content of soda-fountain sirups, in connection with Division of Drugs.

(9) Investigations of the sugar content of barley and malts in connection with the investigations in vegetable physiology.

DAIRY PRODUCTS.

The principal lines of work conducted in the Dairy Laboratory, of which G. E. Patrick is chief, have been as follows:

(1) Analysis of dairy products, including renovated butter, for the Dairy Division of the Bureau of Animal Industry, as in previous years.

(2) Continuation of the analysis of milk, cream, and ice cream sold in the District of Columbia. Report of this work, as it relates to the cream and ice cream, has been published in Bulletin 41 of the Hygienic Laboratory, Public Health and Marine-Hospital Service, Treasury Department.

(3) Analysis of condensed milks sold in the United States, with a study of the question of standards for unsweetened condensed milk.

(4) Studies of methods for the analysis of condensed milks and ice creams, a report upon some of which has been submitted for publication in Bulletin 116 of this Bureau (Proceedings of the Association of Official Agricultural Chemists for 1907).

(5) The analysis of import samples of dairy products taken at the ports of entry and of domestic samples purchased throughout the country by the inspectors under the food and drugs act. Of the import samples examined the greater part have been of the various European cheeses, while the domestic products examined have been mainly interstate samples of milk, condensed milk, and cheese. As a result of the work upon the import goods many shipments of European cheeses have been required to be relabeled—false or misleading labels being replaced by truthful ones—before entering our commerce, and some were found to be so plainly fraudulent as to be entirely denied entrance to the country. It can be positively stated that as a direct result of this work there is a marked improvement in the quality of some of the imported cheeses, as well as in the truthfulness of the labels on this class of goods in general.

As regards the domestic (interstate) samples, their examination has led to a considerable number of prosecutions, in which the trials are now pending. Most of these are cases of adulterated milk.

The total number of samples examined during the year was 588, of which 87 were for the Dairy Division of the Bureau of Animal Industry, 107 were milk and ice cream samples collected in the District of Columbia, 66 were samples of condensed milk from all parts of the country, 50 were import samples from the various ports of entry, 148 were inspectors' samples from interstate commerce, and the balance were miscellaneous samples, including those used in the study of analytical methods.

WORK OF THE MISCELLANEOUS LABORATORY.

During the fiscal year 1,366 samples were examined in the Miscellaneous Laboratory under the direction of J. K. Haywood. Some of these analyses were made as a part of the research work conducted by this laboratory, the results of which either have been published or are being collated and studied for that purpose. Many of the analyses have been made for other laboratories of this Bureau and for the several Bureaus and Divisions of this Department and for other Departments of the Government.

In addition to the experimental and research work much time has been given to the consideration of the correspondence and problems incident to the proper enforcement of that portion of the food and drugs act which applies to waters and foods and remedies for cattle and poultry.

The work of the laboratory is organized under six distinct sections with a specially trained man in charge of each section. These subdivisions are as follows: (1) Waters; (2) cattle foods and grains; (3) insecticides, fungicides, and weed killers; (4) trade wastes; (5) hygienic investigations; (6) miscellaneous.

WATERS.

The water section has examined during the year 85 samples of mineral water. This work, organized on a comprehensive plan in 1902 for the examination of the more important mineral springs of the United States, being continued for the purpose of securing reliable data for the proper enforcement of the food and drugs act. Fifteen samples of bottled mineral and table waters found upon the market have been submitted to analysis, and as a result two prosecutions have been recommended for violation of the misbranding clause of the food law. Twenty-six samples of water were examined for sanitary purposes, 6 for technical purposes, and 4 for irrigating purposes.

In addition to the routine work considerable time has been devoted to research work, looking to the improvement of methods of analysis, particularly with reference to the determination of small amounts of lithium by a spectroscopic method.

CATTLE FOOD AND GRAIN INVESTIGATIONS.

This section has examined during the year 907 samples. Two hundred and thirty of these were commercial feeds, obtained by inspectors on the market, and were examined to determine their compliance with the provisions of the food and drugs act. Fifty samples were found adulterated, or misbranded, and prosecution under said act has been recommended to the Board of Food and Drug Inspection.

In cooperation with the office of Grain Investigations of the Bureau of Plant Industry, 240 samples have been analyzed, as follows: Wheat 61, oats 30, barley 31, rye 8, emmer 6, buckwheat 3. This is a continuation of the investigations begun in 1902 for the purpose of studying the composition and comparative value of new or introduced varieties of cereals for making bread, cereal foods, macaroni, etc., for feeding stock, and for other uses.

In cooperation with the office of Farm Management analyses were made of 210 samples of grasses and forage crops from the arid and semiarid regions for the purpose of studying their relative feeding value. Analyses were also made of 27 samples of corn, 100 samples of potatoes, 71 samples of cassava, and 29 of miscellaneous materials.

In cooperation with the Chicago and St. Paul laboratories baking investigations were conducted to determine the effect of bleaching upon the quality of flour, 52 samples being examined.

Twenty-two samples of miscellaneous feeds were analyzed to determine the variation due to several different methods of sampling.

INSECTICIDES AND FUNGICIDES.

The work of this section during the year has consisted of the analysis of insecticides, fungicides, and weed killers to the number of 108. The majority of these examinations were made at the request of the Bureaus of Entomology and Plant Industry.

Field studies of the action on foliage of lead arsenate and impurities which it contains, in collaboration with the Bureau of Entomology, mentioned in last year's report, have been continued, and the investigation is nearing completion.

Samples of all the brands of lead arsenate that could be found on the American market were collected by the Bureau of Entomology and complete analyses of them have been made. Numerous samples of the chemicals used in the manufacture of lead arsenate were also collected, and analyses of these materials were made for the purpose of determining whether it is practicable to give the orchardist directions for preparing advantageously at home lead arsenate for spraying purposes. This study is practically completed as far as the analytical work is concerned and the results are being collated.

A study of the composition of "self-boiled" lime-sulphur wash was made for the Bureau of Plant Industry. The effect of mixing lead arsenate and lime-sulphur wash, and Paris green and lime-sulphur wash for spraying purposes was also studied at the request of the Bureau of Plant Industry, and some experiments are being conducted on the treatment of binder twine with various materials for the purpose of repelling grasshoppers and other insects which destroy the twine.

Considerable time is given to the study of the methods of analysis of insecticides, in cooperation with the Association of Official Agricultural Chemists.

TRADE WASTES.

This section during the year has examined 109 samples. The investigation of the injury to vegetation by smelter fumes near Ducktown, Tenn., has been continued and part of the results collated and published. The investigation at New Anaconda, Mont., of the injury to animal and vegetable life caused by wastes from smelters and mines has been continued and a preliminary report of the work has been made. Research work, both laboratory and field, has been continued to determine the effect of sulphur dioxid on forests and farm crops, and studies are in progress to determine the effect produced on plants by copper, arsenic, and other trade wastes.

A large part of this work is being performed at the request of the Department of Justice and in cooperation with the Forest Service.

HYGIENIC AND MISCELLANEOUS WORK.

The hygienic work includes investigations relating to the public health, i. e., the examination of wall papers and fabrics for poisonous or deleterious materials, the examination of poisons and poisonous substances in common use, the composition of the atmosphere of schools, public buildings, railroad cars, etc. The work of the miscellaneous section includes investigations of an official and public nature which may be properly made by this Bureau and which are not provided for in other established laboratories. About 100 samples have been examined during the year.

EXAMINATION OF CONTRACT SUPPLIES.

The sample book of the Contracts Laboratory shows 1,238 samples entered for the past fiscal year. This, however, does not really indicate the total number of samples examined, as frequently a large number of examinations are made under one entry. For instance, the 288 numbers assigned to apparatus purchased for the Bureau of Chemistry and examined in this laboratory represent the examination of 5,137 pieces of apparatus. By far the largest amount of work done was for other Departments, as the following summary will show:

	Number of samples.
War Department	96
Navy Department	1
Interior Department	13
Post-Office Department	16
Treasury Department (Bureau of Engraving and Printing)	570
Department of Agriculture (exclusive of Bureau of Chemistry)	18
District of Columbia	6
Government Printing Office	12
Isthmian Canal Commission	82
Bureau of Chemistry (5,137 pieces of apparatus)	288
Miscellaneous	136

The character of substances analyzed was widely varied, including pigments, oils, paints, varnishes, glue, glycerin, ink, typewriter ribbons, carbon papers, inking pads, soap, disinfectants, steel, alloys, and numerous other substances. In the report for the fiscal year ending June 30, 1907, it was stated that an important part of the work had been the examination of supplies for the Bureau of Engraving and Printing; 50 per cent more work has been done for the Bureau of Engraving and Printing during the year just past. Another very important line of new work is the examination of supplies for the

Isthmian Canal Commission, which did not begin until April 28, 1908, 82 samples having been received since that date.

Owing to the large number and varied character of the samples examined for other Departments, it has not been possible to devote more than a small fraction of the time to investigation work, though considerable progress has been made on the study of paints and paint materials, and Bulletin 109, giving some technical methods of testing miscellaneous supplies, principally paints and pigments, has been issued by Percy H. Walker, chief of this laboratory. Much more work has been necessary in examining the supplies bought by the Bureau of Chemistry than was done in the year preceding.

INVESTIGATIONS CONDUCTED BY THE LEATHER AND PAPER LABORATORY.

The number and character of samples received in the Leather and Paper Laboratory during the year are given in the following table:

Paper and paper-making materials	2,463
Leather and leather-making materials	31
Turpentines, tars, oils, and wood products	91
Miscellaneous	47
Total	2,632

TANNING MATERIALS.

The investigation of Sicilian sumacs, which was extended to cover the examination of more recent importations, has been concluded and a report on the subject by F. P. Veitch, chief of laboratory, is now in press (Bulletin 117). The former conclusion that, though the Italian laws forbid the exportation of unmarked adulterated sumac, large quantities of the adulterated material are exported to this country is confirmed, so that it is advisable for all purchasers of sumac who desire a pure article to have consignments examined before accepting them. A number of miscellaneous native tanning materials have been examined during the year, but nothing has been discovered that promises to be of commercial importance.

LEATHERS.

The investigations on leather begun last year are still in progress, and the difficulties encountered in the lack of suitable methods of analysis and testing have been successfully met. This work has been further hampered by lack of sufficient force to handle it satisfactorily, but it can now be developed rapidly.

PAPERS.

The testing work for other Departments of the Government has been continued and has embraced all kinds of papers. In addition to the regular testing of supplies the laboratory has made, at the request of the Post-Office Department, a careful test of the kind and proportions of material used in the stamped envelopes at the mill making this paper, and is also testing the deliveries of paper at the stamped-envelope agency. In addition to checking and testing all deliveries of stamped envelope and postal card papers for the Post-Office Department, the laboratory tests all deliveries of paper to the Government Printing Office, contract samples for the Bureau of Engraving and Printing, and many samples for other Departments of the Government. This testing work has required at times the entire time of the laboratory force and employs three men continually.

A number of samples of new paper-making materials have been examined, with negative results from the industrial viewpoint. The work of the laboratory during the last five years has emphatically demonstrated the fact that the papers now made in this country are of lower quality and are much thicker and heavier than they should be. The practical result of this fact is that the purchasers, of whom the Government is the largest individual buyer, get more paper of inferior quality than is required for their purposes, at a total greater cost, and at a greater expense for transportation, storage, and handling than is necessary, and furthermore the raw materials for paper making in this country are being consumed unwarrantably. The laboratory is now engaged in the preparation of specifications for papers suitable for various purposes the general adoption of which it is estimated will result in a saving of from 10 to 50 per cent of the weight of paper now consumed, without sacrificing the interests of the public, and will at the same time conserve largely the raw materials involved, notably wood, which is the principal substance employed.

TURPENTINES.

The work on wood turpentine has been continued, with especial reference to the improvement of the product as found on the market, in order that it may be adapted for use as a paint and varnish thinner. The tests of commercial wood turpentine as a paint and varnish thinner begun last year have been concluded, and the results will be published as soon as practicable. All turpentines and tars purchased by the Isthmian Canal Commission are referred to this laboratory for examination and constitute an important item.

MISCELLANEOUS WORK.

Work on the distillation of wood has been continued as time permitted, but owing to insufficient force the work has not advanced sufficiently to justify any conclusions.

A number of miscellaneous samples, including fertilizers, peats, and other industrial materials, have been examined during the year for other Bureaus of this Department and for other Departments. The work of the Association of Official Agricultural Chemists and the American Leather Chemists on tanning materials and fertilizers has been shared, and much time has been given to the improvements of the methods of analysis. Important improvements have been made in the methods for examining leather, papers, and turpentines. At the request of the American Chemical Society the laboratory is engaged, with others, in an effort to devise an accurate and suitable method for determining iron and alumina in phosphate rock, a problem of great moment to the fertilizer industry.

MICROCHEMICAL INVESTIGATIONS.

The work of the Microchemical Laboratory, under B. J. Howard, has been conducted along the lines followed in former years, but has increased greatly in volume, and additional assistants have been appointed. Much work has been done in collaboration with the other laboratories and divisions of the Bureau and Department, and other branches of the Government service. The greater part of the work, however, has been done in connection with the enforcement of the food law. For example, spices, including mace, paprika, nutmegs, coriander, caraway, mustards, and peppers, have been examined, 400 samples of peppers alone having been subjected to a microscopical analysis to determine their purity. Among other food products examined were flours—rye flour for detection of wheat or other adulteration, and buckwheat for the detection of foreign products such as wheat and corn products. A considerable number of coffees were analyzed, including the green, roasted, and ground products and various coffee substitutes. Honeys were examined to determine whether they were made from the flowers indicated on the label. Rices were tested for the presence of extraneous materials, such as talc, and coloring matter, such as ultramarine blue.

Lines of food research have included a study of methods for detecting eggs which have been kept in cold storage and are sometimes sold as fresh eggs; a study of pollens from flowers visited by bees in the collection of honey, for the purpose of identifying the floral source of such products when sold in the market; and the examination of several members of the composite and mustard families used as drugs or foods or as adulterants of such products, for the purpose of establishing histological characteristics for their identification.

More attention has been given than formerly to microscopical methods for the determination of the purity of drugs. Among those examined during the year were saffron, sarsaparilla, matico, cannabis indica, coto bark, simaruba, calendula, cumin seed, anise (both the ordinary and star varieties), belladonna root, belladonna leaves, poke root, rhubarb, stramonium leaf, hyoscyamus, gentian, and others. A considerable number of prepared drugs have been examined in collaboration with the Division of Drugs in the enforcement of the food and drugs act and for the Post-Office Department in connection with fraud-order cases.

The need of microchemical methods of identifying many of the alkaloids has arisen in the drug work, and investigations have been carried on with more than forty such bodies. The results thus far obtained indicate that when this work is completed material aid may be given by the microscope in establishing the identity as well as the presence of the members of this interesting group of bodies in drugs and medicines.

Among the inorganic products examined, paints and paint pigments have constituted the largest group, since the microscopical method can be applied in the identification of many of these products. For branches of the Government outside the Department of Agriculture the largest service has been rendered in the examination of papers for the Government Printing Office and the Post-Office Department, for whom over 2,000 samples have been examined. The routine examinations conducted by the laboratory constitute the bulk of work performed and make it rather difficult to carry on research work, but a certain amount is necessary in order to solve new problems of a practical nature which are constantly arising in the analysis of various products.

NITROGEN DETERMINATIONS.

Approximately, 8,750 nitrogen determinations have been made in the Nitrogen Section, in charge of T. C. Trescot, during the last fiscal year, two chemists and a laboratory helper being engaged in the work. The more important samples include those representing the effect of environment on the composition of wheat, received from the section of Vegetable Physiological Chemistry; the excreta analyzed for nitrogen in connection with the experimental table, referred from the section of Animal Physiological Chemistry; the cattle foods, examined primarily in the Miscellaneous Laboratory, although the prosecutions under the food and drugs act are based chiefly on the protein content; and a large number of dairy products, especially cheeses, referred from the Dairy Laboratory, which are also examined in connection with the enforcement of the food law. In the majority of cases only two determinations are made on each sample, although on quite a number, notably the wheats, as many as seven or eight determinations of nitrogen in its various forms are made.

Research work looking to the improvement of the methods for the determination of nitrogen is conducted in cooperation with the Association of Official Agricultural Chemists, the studies of the last year having been devoted especially to the determination of nitrates, with particular reference to fertilizer analysis.

SPECIAL INVESTIGATIONS.

ANIMAL PHYSIOLOGICAL CHEMISTRY.

The laboratory of Animal Physiological Chemistry, in charge of F. C. Weber, as in previous years, has been charged with the conduct of the hygienic table for the study of the influence of preservatives and colors on health and digestion, and the control of the analytical work attendant on the investigation, practically all of which is now performed in this section. The results obtained on the preservatives so far studied have all been compiled and submitted for publication; the reports relating to sulphurous acid and benzoic acid have been issued, and those on formaldehyde, copper sulphate, and potassium nitrate await publication. Several minor investigations for the further study and elucidation of problems arising in connection with this work were completed, among which may be mentioned the working out of a method for the estimation of hippuric acid in the urine, and another for the determination of the acidity of very dilute solutions.

The first series of experiments to determine the effect produced by coca cola on human subjects was completed, and the results are being compiled.

An important study of commercial meat extracts and similar preparations was completed and the results submitted for publication as

Bulletin 114. The chemical work on the effect of cold storage of meats, chickens, quail, and eggs was performed in this laboratory, and the results, extending over a period of two years, have been compiled and submitted as a preliminary report on the subject.

A study of the metabolism of organic and inorganic phosphorus was conducted by feeding these substances to rabbits, and comparative analytical studies were made throughout, as well as a detailed post-mortem examination.

A great deal of work on the study and adaptation of methods was done in connection with the conduct of the food investigations, some of which is not yet completed. Among other miscellaneous studies of this nature may be mentioned one on enzyms resulting in two valuable communications to scientific journals entitled "The Inversion of Cane Sugar by Invertase."

In the prosecution of these investigations 450 samples were examined, representing approximately 900 determinations.

VEGETABLE PHYSIOLOGICAL CHEMISTRY.

The work of the section of Vegetable Physiological Chemistry, in charge of J. A. Le Clerc, is done mostly in collaboration with the various divisions of the Bureau of Plant Industry, principally those concerned with Grain Investigations, Grain Standardization, Dry Land Agriculture, and Seed and Plant Introduction.

During the last year more than 9,000 determinations of the various constituents of cereals and other plants were made in carrying on this collaborative work, covering the analysis of 850 samples. Some of the results obtained show that the white spots so common in wheats during certain years are generally produced by excessive moisture during the growing period. The "triangular" experiments, mentioned in previous reports, show that the climatic conditions have a greater influence upon the composition of grains than have the original composition of seed, time of planting, soil, or other conditions; other investigations show that a large proportion of every plant-food constituent is removed from the growing plant by rainfall, thus affecting most experiments wherein the composition of the final crop is considered in drawing conclusions. The work on American barleys and malts has been continued. The results so far obtained show that the differences in climatic conditions in this country are such that barleys of the highest valuation can be grown either for malting or for feeding, depending upon the locality.

BACTERIOLOGICAL-CHEMICAL INVESTIGATIONS.

WASHINGTON LABORATORY.

The work of the Washington Bacteriological-Chemical Laboratory, in charge of G. W. Stiles, jr., consisted of the partial identification and classification of more than 500 different organisms isolated in pure culture from various sources; the testing of the germicidal, antiseptic, and preservative value of a number of chemical substances; the regular bacteriological investigations of cold-storage beef, ducks, eggs, fish, fowl, and quail; a study of the bacterial content of swelled and unswelled cans of condensed and evaporated milk; bacteriological examinations of waters from many sources (wells, springs, city hydrants, and water coolers) subjected to various treatments (bottled, filtered, distilled, and carbonated).

Examinations were also made of telephone receivers and of cracked dishes from public restaurants. A number of hotels, cafés, lunch counters, milk depots, ice-cream factories, surgical-dressing factories, bakeries, cold-storage plants, boats, abattoirs, etc., were inspected with reference to the sanitary conditions of their ice boxes, refrigerators, and kitchens and the methods employed in handling food products. An important investigation was begun on the bacteriological condition of waters, oysters, and clams from sources subject to sewage contamination. Part of the work on milk, cream, and ice cream has been published by the Marine-Hospital Service.

Work has been done in collaboration with the Division of Foods, Division of Drugs, Miscellaneous Division, and the Dairy, Contracts, Microchemical, Sugar, and Animal Physiology laboratories. For the latter a number of differential leucocyte counts of blood were made.

The samples examined were as follows:

	Number of samples.
Beef, fresh and cold storage	9
Blood, differential leucocyte counts	99
Clams, samples	6
Cultures, identification and classification	517
Dishes, cracked	24
Disinfectants, antiseptics, preservatives, germicidal value	55
Ducks, fresh	4
Eggs, fresh and cold storage	8
Fish, fresh (bass, shad, perch, mackerel)	8
Fowl:	
Cold storage, drawn	2
Cold storage, undrawn	2
Fresh	2
Ice	4
Ice cream	112
Milk and cream	22
Condensed	113
Evaporated	76
Miscellaneous	19
Oysters, samples	26
Quail:	
Cold storage, drawn	2
Cold storage, undrawn	2
Fresh	2
Surgical dressings, gauze, ligatures, etc.	46
Telephone receivers	18
Water:	
City hydrant	19
Miscellaneous	46
Sea	44
Spring, bottled	64
Spring, at source	51
Well	99
Total	894

PHILADELPHIA OFFICE, FOOD RESEARCH.

In this laboratory, under the direction of M. E. Pennington, the investigations have related chiefly to the changes undergone by flesh foods, including milk, when preserved by low temperatures. Some of the results obtained during the study of milk when cold stored were published in the Journal of Biological Chemistry for 1908. It consisted of the examination of various grades of milk, from the purest product obtainable by scientific methods of dairying to the market milk of cities, to determine the kind and extent of the chemical changes taking place during varying periods of storage at 0° or a few degrees below 0° C. Bacterial growth, a factor of such vast importance from the viewpoint of sanitary milk, was also studied, with the astonishing result that it was possible to demonstrate the increase of organisms from a few hundreds per cubic centimeter to billions per cubic centimeter during a period of from four to six weeks, even though the temperature (—1.2° C.) was sufficiently low to cause the formation of a mass of ice crystals which rendered the milk an almost solid mass. Chemical analysis, more especially of the proteins, determining casein, albumin, albumose, peptone, and amido acids, showed that an extensive protein degeneration always took place, sometimes one-half of the casein being changed to lower forms. Corresponding studies made of milk kept at room temperatures show a totally different condition both chemically and bacterially.

The work done on the changes observed in cold-stored chickens has been embodied in Bulletin 115 of the Bureau of Chemistry, and also in a communication sent from the Bureau of Chemistry to the First International Congress of Refrigerating Industries, to be held in Paris during October, 1908, and in an article in the Yearbook of the Department of Agriculture for 1907. The latter article deals with the appearance of fresh and cold-stored chickens, recording for general information, more especially for the housewife, the differences between the two and showing the effects of long periods of storage (a maximum of three years) on the color, texture, and odor of the skin, muscles, and viscera. The investigations which led to this article dealt with chickens prepared and stored for market purposes and purchased from reputable dealers. They were examined chemically, bacteriologically, and histologically, the three examinations being made simultaneously on each bird, or lot of birds, that the information gathered from the three lines of investigation might be correlated. Chemical analyses were made of the light and dark meat separately, determining not only the ash, water, solids, and total nitrogen, but also the distribution of the nitrogen among the various classes of proteins—coagulable proteins, albumoses, peptones, etc.—since it is in this distribution that the effects of long-continued preservation by cold are probably to be found. The analysis of the fat was also made, and the chemical findings abundantly confirm the usual statement that the taste of the fat of cold-stored chickens is much altered. The bacteriological examination showed that organisms were present in the flesh of cold-stored chickens even after four years of hard freezing, and their numbers varied greatly. Growth was prompt, showing that their vitality was not greatly altered. The microscope has been found to be a most valuable aid to the study of cold-stored chickens in that, with proper histological methods of preparation, marked and characteristic changes of the muscle fibers can be demonstrated. In all of this work it has been found necessary to study fresh chickens exactly as the cold-stored fowls are studied, thereby furnishing valuable comparative data concerning one of the most important foods.

Up to the present time the publications from the Philadelphia Food Research Laboratory relating to cold-stored chickens have dealt almost exclusively with chickens of market quality. There are under way, however, experiments to determine the changes taking place in fowls of a known history and kept under the most favorable storage conditions. Experiments are also in progress to determine the temperature at which organisms reproduce when in their natural environment. Another far-reaching study, which has been under way for a number of months, relates to the penetration of the flesh by bacteria, especially those of the alimentary canal, and the relative keeping qualities of drawn and undrawn poultry.

It is believed that only by the coincident study of each sample or experiment from the three points of view, chemical, histological, and bacteriological, with, as far as possible, a correlation of the three lines of information so obtained, will it be possible to define and interpret the changes incident to the decomposition and putridity of foods.

Since this bacteriological-chemical laboratory at Philadelphia is occupied exclusively with research, the statement of the number of samples examined gives no adequate idea of the actual amount of work done, each sample representing seven or eight determinations. All analyses were made in duplicate or triplicate, and in many cases, especially where chickens were involved, the flesh of a number of birds constituted a sample.

	Number of samples.
Chemical analyses of milk	37
Bacteriological examinations of milk	37
Chemical analyses of chickens (light meat, dark meat, and fat)	53
Bacteriological examinations of chicken flesh	101
Histological examinations of chicken flesh	107
Bacteriological examinations of fish	2
Various experiments with condensed milks, involving both chemical and bacteriological work	13
Total	350

ENOLOGICAL CHEMISTRY.

The principal work in enological chemistry undertaken for the year was a continuation of the study of cultures of pure yeasts in relation to the fermentation of fruit juices and the dissemination of these cultures to persons and firms engaged in the manufacture of fruit by-products which require such organisms. These investigations, as heretofore, were in charge of William B. Alwood.

The offer to furnish these cultures was made public in a very limited way, yet requests were received from seventeen States and Territories, representing all sections of the country, and a large number of cultures were sent out. A number of large firms used the cultures, and the reports have been uniformly promising, so much so that the coming season several large factories are intending to use these cultures exclusively. The best results have, however, been reported from individuals who make small quantities of cider and give individual attention to their work.

A study of the use of sulphur in connection with the handling and fermenting of fruit juices was begun and conducted on a commercial scale. This work is not yet complete, but the results thus far obtained are important from both a practical and a technical point of view.

The preparation of pure cider with special yeast cultures, which has been in progress for some time, but was interrupted by the removal of the laboratory from Blacksburg to Charlottesville, Va., was resumed, and some very successful work is nearing completion. This experiment demonstrates clearly the ease with which farmers can make a most wholesome and superior cider for home consumption.

For the purpose of arriving at a more definite idea as to the quality of native American wines and ciders, the Enological Laboratory has begun the collection of these goods where they can be obtained directly from the manufacturer and are of known purity, and especially when made from a known variety of fruit. These samples are analyzed and other important data are collected that the various types of these goods may be defined and standards gradually determined.

The analytical work of the laboratory was not organized until February, 1908, since which time 111 samples have been analyzed, covering 1,567 determinations made in connection with the experiments mentioned and the physiological studies of pure yeast races which is being conducted. The equipment of the laboratory and cellars was greatly increased during the early part of the year, making it possible to conduct the investigations enumerated on a broader scale than formerly.

PUBLICATIONS.

During the fiscal year ending June 30, 1908, twenty bulletins, six circulars, twenty-three food-inspection decisions, and three notices of court judgments have been prepared for publication. Of the bulletins submitted ten, containing 1,649 pages, have been published, six are in press, one proved to be unavailable, and three are awaiting approval.

Including three Yearbook articles, the annual report, and three unnumbered circulars, the total number of pages of original material printed is 1,953, and the equivalent of about 1,200 pages in addition has been submitted and publication is pending.

Five parts of Bulletin 84 were edited, completing to date the record of the investigation of the effect of preservatives and coloring matters on health and digestion as conducted at the experiment table. Parts III to VII treat of sulphurous acid, sodium benzoate, formaldehyde, copper sulphate, and potassium nitrate, each part containing from two to three hundred pages and presenting voluminous analytical data and the discussion thereof.

The revision of the official methods of analysis, as authorized by the Association of Official Agricultural Chemists and prepared by a committee appointed for the purpose, was issued in a preliminary form and again as finally revised (Bulletin 107, and 107 Revised). The importance of this revision, especially in view of the legal standing of the methods in the enforcement of the food laws, can hardly be overestimated, all changes made in the methods during the last nine years having been incorporated, and a logical rearrangement of all general methods and food methods made.

Other important features of the year's publications are the compilation of the State food laws passed during the preceding fiscal year, a large number having been placed on the statute books under the stimulus of the Federal food law (Bulletin 112, Parts 1 and 2); reports on the composition of commercial feeding stuffs and of honey, both of value to the consumer and to those enforcing the food laws; a study made at the instance of the Department of Justice in regard to the injury by smelter fumes to vegetation and animal life; technical methods for the testing of miscellaneous supplies, and the study of pure yeast to be applied in various industries.

As to reprints, although the order (General Order No. 93) restricting the free distribution of bulletins is observed strictly, it was found necessary to reprint 17 bulletins, 17 circulars and separates, and 26 food-inspection decisions, representing 2,802 pages. The food-inspection decisions are distributed as thoroughly as possible, abroad as well as in this country, in order that manufacturers, dealers, importers, foreign manufacturers and exporters, and our consuls abroad may be informed. To effect this, reprints aggregating from ten to twenty thousand a year have been found necessary in many cases, in addition to the original edition of 15,000. The decisions represent 82 pages of original material, covering Food Inspection Decisions 74 to 96, and 126 pages of reprints. These decisions deal with a variety of subjects, most frequently being called forth by the inquiries received from correspondents or some exigency arising in the course of the administration of the law. Their scope may be illustrated by the following subjects: Labeling of mixtures of cane and maple sirups and of corn sirup; labeling of coffees; of bitters; of medicinal and table waters; the use of certain preservatives, dyes, and coloring materials in foods; restrictions and explanations as to the proper use of guaranties and serial numbers.

A new series of circulars, giving notice of court judgments, was inaugurated during the year in accordance with section 4 of the food and drugs act, which provides that "after judgment of the court, notice shall be given in such manner as may be prescribed by the rules and regulations." Three of these have been issued, covering the misbranding of apple cider, molasses, and flour.

While the supplies needed by the seventeen port laboratories and the main office have, of course, increased greatly in volume, an effort has been made to reduce the number of forms, circular letters, etc., to a minimum, and to order in as large quantities as storage room would permit. The number of orders for job printing has not, therefore, greatly increased, amounting to 476, including 155 orders on the photographic laboratory, as compared with 337 in the previous year.

To bring the work in arrears up to date (i. e., the checking and editing of the five food-table reports mentioned) a temporary appointment was made for about nine months, in addition to the appointment of a permanent assistant to the editorial clerk which was made in September.

THE LIBRARY.

During the year 3,064 books were added to the library, 2,812 of which were shipped to 20 branch libraries in the laboratories outside of Washington, each of which has been provided with a card catalogue of the books deposited in it. The books for two more laboratories have been bought and catalogued and will be shipped as soon as the laboratories are opened. One hundred and forty journals were subscribed for, received, recorded, and forwarded to the branch laboratories, and 399 books were bound for use in various laboratories in Washington and elsewhere.

The current daily work of the library has been much increased by the larger number of persons using it and also by the amount of research work required, especially in connection with the food work, viewed both in its scientific and in its administrative aspect. This growth has interfered with the systematic translating and indexing of much material useful to the Bureau of Chemistry, which work should be provided for in the future.

CLERICAL WORK.

The clerical work of the Bureau was particularly increased in connection with the purchase and distribution of supplies for the eleven new branch laboratories, travel and other expense vouchers, notably for inspectors, records of inspection work, records of the analyses of imported and interstate samples, and records of pending cases and hearings under the food and drugs act. An itemized statement of the volume of this work is as follows:

Approximate number of letters written	100,000
Purchasing orders	2,925
Vouchers examined	6,544
Serial numbers for guaranties recorded and issued in connection with the food and drugs act	7,885
Letters of authorization issued	523
Contracts	24
Leases	25
Quotations, informal, secured	2,550

Card-index records were kept of fiscal transactions, letter files, permanent property, chemical analyses, cost of projects and divisions, receipts and distribution of supplies, guaranties, interstate and imported food and drug cases, time and efficiency records of employees, certifications, examination papers, inspections, and miscellaneous matters.

A general storeroom was established in Washington from which chemicals and chemical apparatus will be distributed to the branches. Heretofore, owing to limited storeroom, it has been necessary to have a large part of the supplies shipped directly from the dealers to the branches and no uniformity could be insured. Now all supplies are tested in the Contracts Laboratory and the Division of Drugs before being accepted, thus insuring a high and uniform grade of chemicals and apparatus for the branch laboratories. Requisitions from these laboratories can now be filled more promptly, and lower prices are obtained by purchasing larger amounts.

The cost-keeping system inaugurated during the previous year has been worked out in detail and is proving satisfactory.

Owing to the fact that all drug and food inspectors and a large proportion of the men placed in charge of branch laboratories were new in the service and not familiar with the Department's methods and regulations for incurring expenses and making out travel and other expense vouchers, it was necessary to instruct them in detail in these matters, and the work involved a large amount of correspondence.

It has been the aim to classify the work of clerks and fix salaries, as far as practicable with present statutory grades in accordance with the plan adopted by the Keep Commission. All statutory grades below $900 per annum have been discontinued.

WORK OUTLINED FOR THE FISCAL YEAR ENDING JUNE 30, 1909.

OFFICE OF CHIEF INSPECTOR.

The principal work for the ensuing year will be the collection of official samples. These samples will cover certain listed products of both foods and drugs concerning which there is a definite policy of prosecution, and in the case of foods do not include those products in which preservatives are used, pending the decision of the Referee Board.

It is not irrelevant at this point to indicate the difficulty of the inspector's task in securing samples. The conditions obtaining in the collection of such samples for State prosecution are materially different from those under which samples must be collected for prosecutions under the Federal act. In the first case it is not necessary to show an interstate transaction nor that the goods were received by the dealer subsequent to January 1, 1907, or any other date; it is not necessary to make collection in original unbroken packages nor to have such samples identified with the shipment received at any particular time. Provisions are made in the State laws which impose usually heavy penalties for the refusal of a merchant to sell or deliver a sample to the inspector under the conditions prescribed by the act. There is a marked difference between the performance of inspectors' duties, for which the inspector is clothed with every police power conferred by the State, and a similar collection, requiring the ascertainment of vastly more data, under circumstances wherein the inspector must rely solely upon his own initiative.

The availability of the inspecting force will be materially decreased by their attendance as witnesses upon the cases pending from the past year's work. This will leave little time for the consideration of special investigations. Short assignments are also necessary from time to time to determine certain facts in connection with particular violations which may be considered properly a part of routine inspection duty, but in their very nature can not be indicated in advance. Such work requires much time and, being closely connected with prosecutions, demands immediate attention, thereby interrupting duties outlined for the particular inspector concerning the collection of samples of a totally different kind. The necessity of increasing the inspecting force is therefore apparent.

The extensive investigations begun the past year for the suppression of interstate sale of distilled, malt, and wine vinegars as apple or cider vinegar will be continued, as will also those devoted to the adulteration and misbranding of spurious liquors and whiskies.

Milk investigations similar to the one conducted last year at St. Louis will be undertaken at various cities so located that a large portion of the supply enters into interstate commerce at those points.

An investigation of the marketing of sophisticated waters, represented to be the natural product of mineral springs, will be rigorously pursued and steps taken to suppress such trade practices.

The effort to suppress the practice of branding inferior grades of coffee as Mocha and Java and domestic cheese as imported products will be increased.

Instructions have also been issued to reach millers and commission merchants dealing in stock feed who adulterate wheat products in wholesale quantities by the addition of rice hulls, corn-cob meal, and other adulterants, or color such an admixture or a poorer grade of pure bran with coal-tar dyes to conceal inferiority.

Finally, a systematic campaign will be instituted against the extensive practice of overmarking canned goods and staple products, these frequently being found upon examination to be from 15 to 25 per cent underweight.

DIVISION OF FOODS.

Much time will be occupied with the routine administrative work of the Bureau, the correspondence relative to the enforcement of the food and drugs act, and the questions relating to the organization of the new branch laboratories now in course of construction, the volume of this work being constantly increasing.

The investigation of lemon oil with special reference to the samples collected in Sicily by the assistant chief of division during the last fiscal year will be brought to completion, and the study of fruits in collaboration with the pomologist in charge of Field Investigations in Pomology, Bureau of Plant Industry, will be continued.

The study of analytical methods for determining the quality and purity of foods will also be continued, and from time to time special investigations of particular classes of food, in localities where they enter largely into interstate commerce, will be conducted.

The manufacture without the use of preservatives of foods ordinarily treated with chemicals for this purpose will be further investigated and the study extended to a wider range of products.

The work of the food-inspection laboratory will be a continuation of the special work for which the laboratory was established—that is, the checking of results and methods and the examination of the regular food-inspection samples of this locality and those referred from the branch laboratories for confirmation. The great increase in the number of food-inspection laboratories will result in a corresponding increase in this work of checking analytical results. More extensive work will also be conducted along the line of unifying methods for reporting results of analyses in the various food-inspection laboratories.

In addition, the study of the maturing of spirits will be continued and the composition of the solids and flavoring matters in whiskies will also be investigated. These studies will include the determination of fusel oil and other methods of analysis of distilled spirits and an extensive cooperative test of these methods in the various laboratories of the Bureau, as well as with other chemists interested in the subject.

DIVISION OF DRUGS.

The work for the fiscal year ending June 30, 1909, will continue along the same lines as those of the last year, but will be more specialized in view of the fact that four new laboratories have been established in the Division of Drugs, namely, the drug-inspection laboratory, synthetic-products laboratory, the pharmacological laboratory, and the essential-oil laboratory.

The work of the drug-inspection laboratory will consist chiefly in analyzing and keeping systematic records of all domestic and imported drug products not provided for by special laboratories.

The duty of the synthetic-products laboratory consists in making an investigation of synthetic products and the preparations used in their manufacture, in determining their purity, and establishing methods of analysis by means of which they may be detected or estimated. Methods of analysis thus elaborated which appear to give satisfactory results will be tested by the cooperation of chemists throughout the United States, using known and unknown material.

The pharmacological laboratory will undertake various studies of simple and mixed drugs for the purpose of determining their action upon the animal economy, such as the influence of caffein and caffein products on metabolism, also to what extent one drug may counteract the undesirable effects of another. Physiological tests of drug products will also be made for the purpose of determining their activity and usefulness for medicinal purposes and to elaborate methods which will serve to confirm the presence of certain potent agents when indicated by chemical analysis.

The essential-oil laboratory will investigate essential oils and products in the manufacture of which the same are used; the lines of work to be first instituted in this connection include the study of Pharmacopœial standards of essential oils and investigations as to the variability of genuine oils; comparisons of chemical and physical properties of oils of different origin and produced under different conditions; and the character and extent of adulterations. The special oils to be first investigated include cassia, peppermint, santal, thyme, etc.

MISCELLANEOUS DIVISION.

By order of the Secretary, dated July 1, 1908, the Miscellaneous Laboratory was made a Division, and the following laboratories were created therein: (1) Water; (2) cattle food and grain investigation; (3) insecticide and fungicide; (4) trade wastes. The studies and investigations planned for the year ending June 30, 1909, are as follows:

WATER LABORATORY.

(1) The composition and character of mineral waters of the United States. (2) Table and medicinal waters found on the market, for the purpose of securing data for the enforcement of the food and drugs act. (3) Water supplies of cities, towns, etc., when the exigencies of the public service demand the same. (4) Irrigating waters in cooperation with the Irrigation Investigations of the Office of Experiment Stations. (5) Improvement of methods of analysis of mineral waters, especially methods for determining small amounts of lithium, and the examination of certain springs for radio-active properties.

CATTLE-FOOD AND GRAIN INVESTIGATION LABORATORY.

(1) The composition of American cattle foods as they appear on the American market, especially as it relates to the enforcement of

the food and drugs act. (2) In collaboration with the office of Farm Management of the Bureau of Plant Industry, forage and range crops of the arid and semiarid West, and also malts and barleys. (3) Feeding value, commercial importance, and adaptability of grains, in collaboration with the office of Grain Investigations of the Bureau of Plant Industry. (4) Milling and baking qualities of cereals will be continued and the effect of bleaching upon flour.

INSECTICIDE AND FUNGICIDE LABORATORY.

In cooperation with the Bureau of Entomology the following studies will be pursued: (1) Lead arsenate and other insecticides upon the market and materials used in preparing them. (2) The injury to foliage by certain insecticides. (3) The chemical changes which take place when lead arsenate and Bordeaux mixture are mixed and sprayed upon foliage. (4) Studies of methods of analysis of insecticides, in cooperation with the Association of Official Agricultural Chemists.

TRADE WASTES.

(1) Arsenic and other poisons in fabrics and other materials. (2) Effect of sulphur dioxid upon different species of plants. (3) Resisting power of certain plants to copper, arsenic, and other smelter wastes.

HYGIENIC AND MISCELLANEOUS.

(1) Arsenic and other poisons in fabrics and other materials. (2) Disinfectants, methods of manufacture, and practical value of such compounds. (3) The atmosphere of schools, public buildings, and railroad cars, etc.

SUGAR LABORATORY.

The plans for the work of the fiscal year ending June 30, 1909, are in large part a continuation of the investigations already described in so far as they have not been finished, and may be outlined as follows:

(1) Continuation of the studies regarding the effect of environment upon the sugar content of Indian sweet corn. This work was begun three years ago and will be continued as outlined one year more. The results will indicate in general the latitudes in which sugar corn of the highest sugar content is produced, also the changes in sugar content of the same variety of corn when grown in different localities. In connection with this work the Sugar Laboratory is collaborating with the Bureau of Plant Industry in corn selection for increasing the content of sugar.

(2) The collection and analysis of samples of honey imported into the United States. In this connection studies will be made of the effect of heating and of storage on the composition of the honey, and methods for determining adulterants will be studied.

(3) The composition of cane molasses and sirup, especially with a view to determining the admixture of small quantities of commercial glucose, will be investigated.

(4) The analysis of samples of beet molasses already collected, to determine the effect of environment and process of manufacture upon the composition.

(5) A study of methods of determining sugar in the beet. This is of great importance to the beet-raising farmer, as well as to the manufacturer of sugar, as the price paid for beets depends generally on the per cent of sugar found by analysis.

(6) A study of the composition of the extract of maple wood, hickory bark, corncobs, etc. It is proposed to determine, if possible, the constants of such materials, that they may be used in maple products investigations.

(7) A continuation of the work upon malt and diastatic preparations. This is work which has been been done in past years partly in collaboration with the Drug Laboratory, and will be extended so as to include a large variety of commercial products.

(8) A continuation of the work upon chemical methods employed in the analysis of sugar and carbohydrates. This is primarily referee work for the Association of Official Agricultural Chemists, and includes a study of methods used for honeys, sugars, molasses, dextrins, malt products, etc.

(9) A continuation of the work on the manufacture of alcohol from farm wastes and agricultural products. Up to this time the work has been conducted on small quantities of various materials, but a plant manufacturing about 75 gallons of alcohol in a day of seven hours is now in process of installation at the Bureau of Chemistry. It is proposed to use the most important types of agricultural products and wastes for making industrial alcohol, such as corn, potatoes, cull fruits, watermelons, and cantaloupes; also canning wastes from corn canneries, such as cobs, etc., and molasses, running the plant three or four days with each material. From the data obtained the commercial yield and cost of manufacture may be estimated and the availability of the particular material for alcohol-making on a commercial scale determined. A course of lectures on fermentation and alcohol-making will accompany this experiment, and a representative from each experiment station will be requested to be present and participate in the work.

DAIRY LABORATORY.

Aside from the analytical problems arising in connection with the routine work, two milk studies are contemplated.

(1) A study of the process of condensing milk, with the object of determining the practical limit of condensation consistent with a good mechanical condition.

(2) A study of the composition of cow's milk produced in the States of Washington and Oregon, as compared with that produced in other sections of the country.

LEATHER AND PAPER LABORATORY.

The following investigations, some of which are continued from last year, are planned for the Leather and Paper Laboratory:

(1) Investigations of sole, harness, and bookbinding leathers, with especial reference to the qualities that determine their value in service.

(2) Principles of rapid tanning.

(3) Continuation of the study of paper for various uses and the preparation of standard specifications for such paper.

(4) Continuation of the testing of paper for other Departments of the Government. Special work in addition to the regular work along this line has already been asked for by one of the Departments.

(5) Investigation of new raw materials for pulp and paper making.

(6) Continuation of the work on the production and industrial uses of wood turpentines and heavy oils.

(7) Study of the adulteration of turpentines.

(8) Continuation of the work on the destructive distillation of woods, with particular reference to increasing the yields of products.

CONTRACTS LABORATORY.

The work for the fiscal year ending June 30, 1909, will be along the same lines as that of the year preceding. As much time as possible will be devoted to the study of paints and paint materials. It is also proposed to do some work on the methods of analysis of alloys. The very rapidly increasing amount of work requested by other branches of the Government makes it evident that the Contracts Laboratory will require very much more space and a number of additional chemists. During the last six months of the fiscal year ended June 30, 1908, practically no work of investigation was done, the whole force being fully occupied with routine work in the examination of samples from other Departments, and during a great part of the time it was necessary to borrow additional chemists from other laboratories.

The new work demanded by the Isthmian Canal Commission and the rapidly increasing orders received from the Bureau of Engraving and Printing may be especially specified as large items of increase in the work of the coming year.

MICROCHEMICAL LABORATORY.

In addition to continuing the routine examination in collaboration with the other laboratories of the Bureau the following special studies will be made:

Microchemical examinations of eggs in cold storage, histological examinations of cold-storage fish, investigations looking to the identification of alkaloids in drug products by means of the miscroscope and histological studies of drugs in general, and an extensive study of mustards for the preparation of standards.

SPECIAL INVESTIGATIONS.

ANIMAL PHYSIOLOGICAL CHEMISTRY.

The work for the coming year will include a continuation of the metabolism experiments, especially the study of coca cola; the determination of purin bodies in American foodstuffs; the chemical work in connection with the investigation of the deterioration of food products; experiments in animal feeding in connection with both the preservative work, and the question of the deterioration of foods under varying conditions of storage; the application of the enzym studies to the work on foods, and studies of methods of analysis.

VEGETABLE PHYSIOLOGICAL CHEMISTRY.

During 1908 the following studies will be prosecuted: Influence of environment on the composition of grains and the products therefrom; the influence of plant food on the composition of plants; the chemistry of plants during different periods of growth; the changes in the composition of grains during storage, germination, and malting; the comparative composition of frozen and normal wheats, and the food value of the organic phosphorus of grains.

BACTERIOLOGICAL CHEMISTRY.

Washington Office.—In addition to the regular routine investigations as outlined in the summary of last year's operations and the cooperative work with other laboratories of the Bureau (giving special attention to the bacteriology of food products and their wholesomeness from this point of view), the following investigations are contemplated or in progress:

(1) The determination of the germicidal value of various chemicals and of such juices as those from lemons, limes, and other citrus fruits, cocoanut, gooseberry, blackberry, raspberry, strawberry, currants, apples, peaches, etc.

(2) The work already begun on the examination of mineral waters at their source, and of the bottled market product, will probably be completed.

(3) Investigations of the bacterial content of various vegetables consumed in the raw state, giving special consideration to their possibility of disease transmission when grown under conditions liable to pollution from sewage and waste products.

(4) "The bacteriology of the fly and its dangers" is a problem that should be studied in the most minute detail, since in the crusade for cleanliness of food products and improved sanitary conditions this factor must be seriously considered.

(5) Extended investigations of the oyster industry will be made as time and opportunity permit.

Philadelphia Office.—This section of the work was formally organized as the food research laboratory on July 1, 1908.

During the fiscal year ending June 30, 1909, it is proposed to conduct in and under the direction of this laboratory investigations bearing upon the alterations undergone by preserved foods, following as well as broadening and extending the lines of work reported in 1907–8. Such investigations will necessitate chemical analyses and bacterial examinations of the foods and in many cases a histological study will also be prosecuted since this line of work has yielded valuable results.

It is planned to continue the study of stored chickens and to extend the work to poultry in general and various meats in search of information to assist in the enforcing of the food and drugs act.

The study of milk will also be continued from a chemico-bacteriological standpoint, and it is intended to take up especially the action of bacterial and naturally occurring enzyms in their relation to milk decomposition.

PURE RACES OF YEAST.—The cellar studies in progress will be extended to include a dozen races of pure yeast in grape and apple juice, with unsown casks for comparison, all in commercial quantities. In the laboratory the ability of these yeasts to break up given percentages of sugar will be determined. The latter experiment will be conducted in champagne bottles to determine the quantity of sugar to be used in champagnizing fruit juices. The data secured will make it possible to state accurately what effect a given yeast will produce under given conditions.

The quantity of pure yeast that should be used in fruit juices or fruit pulp in factory work to secure dominant fermentation, thus excluding malferments, will also be investigated. The isolation of new races of yeast and the study of their physiological peculiarities as relates to the development of the fermentation industries will be studied as the current work permits and the use of the pure yeasts already tested will be extended as rapidly as possible.

REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., October 10, 1908.

Sir: I have the honor to transmit herewith a report covering the operations of the Bureau of Soils for the fiscal year ending June 30, 1908. The report covers separately the work accomplished in the Soil Survey, in the Division of Soil Utilization, and in the Laboratories, and in addition embodies recommendations for the extension of the work during the ensuing year.

Respectfully,

Milton Whitney,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PROGRESS OF THE SOIL SURVEY.

THE YEAR'S WORK.

During the fiscal year ended June 30, 1908, soil survey work was completed or begun in 37 different areas located in 20 different States. The surveys were assigned to these areas to meet the requirements of the most urgent requests on file at the office of the Bureau of Soils, while at the same time extending the general knowledge of the Department of Agriculture concerning the major soil groups and the principal agricultural regions of the United States. The general plan has been kept in mind of securing such a thorough distribution of soil survey areas in different portions of the United States as will ultimately lead to a complete knowledge of all of the different classes of soils which are found within the continental portion of the country. As a result of the distribution of soil survey areas both during the fiscal year ended June 30, 1908, and during preceding years, the Bureau of Soils has been able to complete a general classification of all of the soils of the United States. This is the first time that such a classification has been worked out in any country of the world, and marks an important step in advance in soil knowledge.

During the year a total area of 17,831 square miles was mapped, at an average cost of $3.58 per square mile, or about one-half cent per acre. This cost per square mile has slowly increased. At the present time improvements in the soil survey methods, due particularly to the increased and more detailed knowledge of soils accumulated through previous surveys, enable the experts of the Bureau of Soils to determine and represent on maps in much greater detail the different soil conditions encountered than was the case in the earlier surveys. Until considerable experience had thus been gained, and particularly until a sufficient number of areas had been surveyed to outline the general classification of the soils, it was necessary to use somewhat less detail and to generalize more or less broadly concerning the soil conditions and their relationship to crops. The added experience and knowledge of later years have enabled the soil survey field men to observe more narrow distinctions, to map smaller unit areas of different soils, and thus to increase the accuracy and detail of the work. This has resulted in better maps and in greater precision, but it has also required a longer time to make examination of each square mile, and this increase in accuracy has slowly increased the cost of the work. This tendency has been offset to a large degree, though not completely, by the added skill of the men in identifying and recording such details.

In addition, the average cost of certain areas which were in process of survey during the winter months of 1907–8 was also increased from the fact that unusually adverse weather conditions rendered the rate of field mapping slower, and decreased the mileage covered during that season in undue proportion to the necessary expenses of the parties at work. Under more favorable conditions the cost of work per square mile in certain areas in Alabama, Mississippi, and Louisiana could have been reduced from 40 to 50 per cent from the cost as shown.

Individual areas surveyed and mapped and cost of field work during the fiscal year ended June 30, 1908.[a]

State.	Area.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
Alabama	Autauga County	640	4.50	[c] 2,877.35
	Baldwin County	750	3.71	[d] 2,781.84
	Bibb County	520	4.60	[e] 2,391.12
	Henry County	550	6.59	[f] 3,624.37
	Lamar County	600	3.10	[g] 1,858.38
California	Modesto area	820	6.46	5,299.57
	Portersville area	335	6.17	2,068.00
	Redding area	200	7.08	1,416.84
Georgia	Grady County	315	3.46	1,088.54
	Thomas County	535	3.46	1,849.74
Idaho	Minidoka area	146	4.41	642.82
Indiana	Marion County	[b] 290	2.03	587.72
Louisiana	Bienville Parish	856	3.13	2,676.80
	East and West Carroll parishes	747	2.57	1,920.17
	Winn Parish	[b] 153	5.62	861.82
Maryland	Easton area	966	2.12	2,052.61
Mississippi	Holmes County	825	1.35	1,109.77
	Monroe County	762	5.02	3,828.58
Nebraska	North Platte area	[b] 210	2.64	553.45
New York	Dutchess County	[b] 745	2.64	1,966.10
North Carolina	Henderson County	[b] 319	2.69	[h] 858.97
	Robeson County	[b] 945	3.61	[i] 3,410.97
North Dakota	McKenzie area	348	4.45	[j] 1,550.14
	Morton area	[b] 436	3.11	[k] 1,357.10
Pennsylvania	Center County	[b] 197	5.19	1,022.83
	Johnstown area	[b] 558	2.37	1,326.11
South Carolina	Lee County	[b] 153	3.84	589.00
	Oconee County	652	2.77	1,804.25
	Sumter County	[b] 154	3.84	592.85

[a] This includes the salaries of the men while in the area and their subsistence expenses, but not cost of transportation to and from the area.

[b] These figures do not include portions of these areas surveyed in preceding years.

[c] Of this amount $1,320.49 was paid by the State of Alabama.

[d] Of this amount $1,425.81 was paid by the State of Alabama.

[e] Of this amount $459.80 was paid by the State of Alabama.

[f] Of this amount $1,382.16 was paid by the State of Alabama.

[g] Of this amount $970.96 was paid by the State of Alabama.

[h] Of this amount $436.17 was paid by the North Carolina Department of Agriculture.

[i] Of this amount $840.28 was paid by the North Carolina Department of Agriculture.

[j] Of this amount $353.10 was paid by the Agricultural and Economic Geological Survey of North Dakota.

[k] Of this amount $329.17 was paid by the Agricultural and Economic Geological Survey of North Dakota.

Individual areas surveyed and mapped and cost of field work during the fiscal year ended June 30, 1908—Continued.

State.	Area.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
South Dakota	Belle Fourche area	[a] 98	7.60	742.20
Tennessee	Giles County	[a] 599	2.44	1,463.04
Texs	Corpus Christi area	400	3.50	1,400.42
	Franklin County	325	4.08	1,326.29
Virginia	Montgomery County	[a] 353	3.32	1,174.03
Washington	Bellingham area	[a] 361	4.12	1,485.86
West Virginia	Middlebourne area	[a] 806	2.36	[b] 1,902.39
	Parkersburg area	162	2.72	440.14
	Total	17,831	3.58	63,902.18

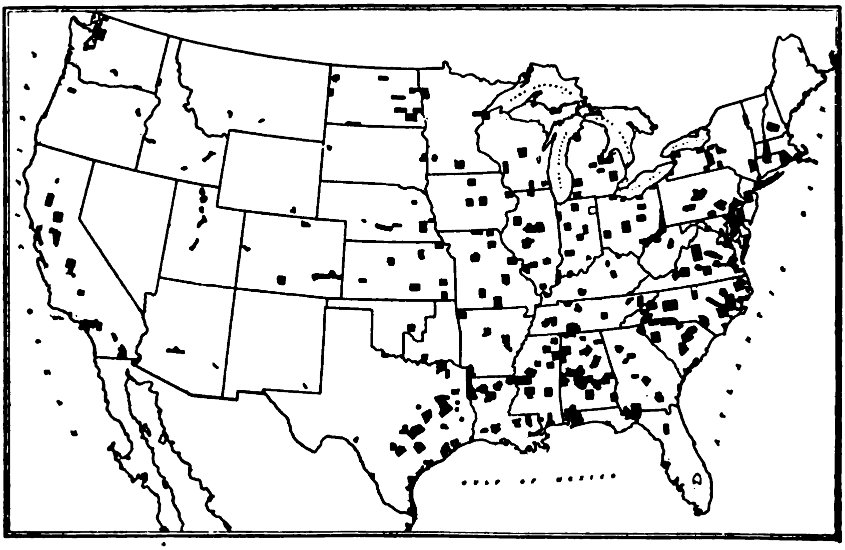
[a] These figures do not include portions of these areas surveyed in preceding years.
[b] Of this amount $799.64 was paid by the West Virginia Geological Survey.

Total areas surveyed and mapped in the several States during the fiscal year ended June 30, 1908, and the areas previously reported.

State or Territory.	Area surveyed during 1908.	Area previously reported.	Total area surveyed.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Alabama	3,060	9,757	12,817	8,202,880
Arizona		611	611	391,040
Arkansas		2,677	2,677	1,713,280
California	1,355	7,091	8,446	5,405,440
Colorado		2,428	2,428	1,553,920
Connecticut		518	518	331,520
Delaware		314	314	200,960
Florida		2,973	2,973	1,902,720
Georgia	850	2,422	3,272	2,094,080
Idaho	146	1,135	1,281	819,840
Illinois		5,925	5,925	3,792,000
Indiana	290	3,247	3,537	2,263,680
Iowa		2,303	2,303	1,473,920
Kansas		3,175	3,175	2,032,000
Kentucky		2,049	2,049	1,311,360
Louisiana	1,756	5,200	6,956	4,451,840
Maryland	966	2,663	3,629	2,322,560
Massachusetts		796	796	509,440
Michigan		3,788	3,788	2,424,320
Minnesota		2,197	2,197	1,406,080
Mississippi	1,587	5,318	6,905	4,419,200
Missouri		5,093	5,093	3,259,520
Montana		432	432	276,480
Nebraska	210	2,906	3,116	1,994,240
New Hampshire		923	923	590,720
New Jersey		1,303	1,303	833,920
New Mexico		129	129	82,560
New York	745	4,853	5,598	3,582,720
North Carolina	1,264	8,011	9,275	5,936,000
North Dakota	784	3,794	4,578	2,929,920
Ohio		4,183	4,183	2,677,120
Oklahoma		1,160	1,160	742,400
Oregon		446	446	285,440
Pennsylvania	755	3,270	4,025	2,576,000
Porto Rico		330	330	211,200
Rhode Island		1,085	1,085	694,400
South Carolina	959	5,347	6,306	4,035,840
South Dakota	98	577	675	432,000
Tennessee	599	4,143	4,742	3,034,880
Texas	725	12,467	13,192	8,442,880
Utah		1,501	1,501	960,640
Vermont		227	227	145,280
Virginia	353	5,534	5,887	3,767,680
Washington	361	1,291	1,652	1,057,280
West Virginia	968	809	1.777	1,137,280
Wisconsin		2,537	2,537	1,623,680
Wyoming		309	309	197,760
Total	17,831	139,247	157,078	100,529,920

GENERAL STATUS OF SOIL SURVEY WORK AT THE END OF THE FISCAL YEAR 1908.

With the completion of the fiscal year 1908 soil surveys have been undertaken in all but two States in the United States. The largest area which has been covered in any particular State has been in Texas, which is also the largest State in the Union, where 8,442,880 acres of land have been surveyed. The second largest area has been completed in Alabama, owing in this case to direct State cooperation with the Bureau of Soils and the appropriation of funds from the State treasury to increase the amount of work to be annually completed within the State. Considerable areas have also been covered in North Carolina, California, Mississippi, Louisiana, Illinois, South Carolina, New York, Virginia, Tennessee, Missouri, and North Dakota. In each of these States 3,000,000 acres or more have been covered by soil surveys.



Distribution of soil surveys.

In spite of the progress which has been accomplished in these and in other States, the percentage of land area covered by the surveys compared with the total land area of the different States is in the majority of cases extremely low. (See sketch map.)

In this connection the cost of the soil survey work from the inception of the field operations of the Bureau of Soils in 1899 until June 30, 1908, is given in a separate table in this report. During that period the Bureau of Soils has expended a total of approximately $403,000 in the soil survey field work, covering a total area of 157,078 square miles, making an average cost of $2.57 per square mile. The largest amounts expended have been in California, Texas, Alabama, Louisiana, Mississippi, North Carolina, South Carolina, Virginia, New York, North Dakota, Tennessee, Georgia, Florida, Colorado,
Illinois.

California nearly $41,000 has been expended in making soil sur-
of a total area of 8,446 square miles. The cost during the fiscal

year and during previous years has been at a high rate because of the fact that great detail is employed in the making of the maps, and also because of the fact that in addition to the ordinary soil map it is necessary to make a map showing the nature and concentration of the alkali salts in many areas. This is true in all of the irrigation States. The sums expended in Texas represent only an average amount of money when compared with the total land area of the State. The amount expended in Alabama represents an effort on the part of both the Bureau of Soils and the State of Alabama, through cooperative work, to complete the soil survey of the State at an early date, when all expenditures for this purpose within the State will naturally cease. The variation in expenditures in other States represents practically a distribution of funds in proportion to the existing demands for the work, considered in connection with the necessity for the early completion of work, and in connection with the immediate results which the surveys are likely to produce.

It is to be noticed in connection with this table that in only ten States have the expenditures for soil survey work yet aggregated $10,000 or more during the entire period during which the work has been conducted. This relationship of work which has been done in the past to current needs is constantly held in mind at all times in the distribution of additional soil survey areas and funds.

The following table shows the cost of work to June 30, 1908, by States:

Cost of soil surveys, May, 1899, to June 30, 1908.

State or Territory.	Cost.	State or Territory.	Cost.
Alabama	$35,758	New Jersey	$2,477
Arizona	4,602	New Mexico	1,200
Arkansas	7,512	New York	14,176
California	40,883	North Carolina	19,730
Colorado	8,307	North Dakota	11,208
Connecticut	986	Ohio	7,567
Delaware	498	Oklahoma	3,218
Florida	9,876	Oregon	1,856
Georgia	8,426	Pennsylvania	8,654
Idaho	2,768	Porto Rico	1,930
Illinois	8,634	Rhode Island	1,654
Indiana	7,365	South Carolina	15,010
Iowa	3,055	South Dakota	2,280
Kansas	6,784	Tennessee	9,204
Kentucky	3,982	Texas	35,546
Louisiana	20,494	Utah	6,608
Maryland	6,450	Vermont	528
Massachusetts	1,511	Virginia	14,674
Michigan	8,307	Washington	4,976
Minnesota	5,155	West Virginia	4,338
Mississippi	20,563	Wisconsin	5,479
Missouri	7,993	Wyoming	1,070
Montana	1,900		
Nebraska	5,980	Total	402,997
New Hampshire	2,126		

WORK BEGUN.

For the fiscal year ending June 30, 1909, the additional funds made available for soil survey work enabled the Bureau to undertake the examination of 62 different areas located in 27 different States, and covering a total area of 38,944 square miles. In addition to this detailed soil survey work, the funds placed at the disposal of the Bureau also enabled it to undertake in a vigorous way the reconnoissance soil survey work in the Great Plains region, where conditions favorable to dry-land farming exist. As a result, areas in this region aggregating 118,809 square miles were assigned, and the work was begun prior to June 30, 1908.

The purpose of this work is to make a reconnoissance survey, on a scale of 6 miles to the inch, of practically all of the agricultural lands lying west of the one hundredth meridian and east of the Rocky Mountains. The survey will determine what proportion of this area is suited to farming operations and the location of such soils as can be successfully tilled under the most modern methods for crop production with conditions of scanty rainfall.

In addition work was assigned and begun in the reconnoissance of the Appalachian Mountain and Plateau region, in order to determine what proportion of the land within this section was suited to the production of agricultural crops, and what proportion was better suited to forest occupation and other uses than crop production. In the table following the assignments worked out at the close of the fiscal year just ended are shown in detail.

Assignments of soil areas to be surveyed in fiscal year 1909.

State.	Number of areas.	Total area.
		Sq. miles.
Alabama	15	10,212
Arkansas	1	788
California	4	2,446
Florida	1	963
Georgia	4	1,361
Indiana	1	660
Kentucky	1	808
Louisiana	1	564
Maine	1	500
Maryland	1	425
Michigan	1	575
Minnesota	1	497
Mississippi	2	899
Missouri	2	1,436
Nevada	1	500
New York	3	2,013
North Carolina	4	1,786
North Dakota	1	1,445
Oklahoma	1	800
Oregon	2	1,000
Pennsylvania	2	2,024
South Carolina	3	1,694
Tennessee	3	1,421
Texas	2	1,912
Virginia	2	1,159
West Virginia	1	956
Wisconsin	1	600
Total detailed surveys	62	38,944
Reconnoissance, Great Plains		118,809
Reconnoissance, Appalachian		16,200
Grand total		173,953

RECOMMENDATIONS FOR FUTURE WORK.

THE PRESENT REQUIREMENTS OF THE SOIL SURVEY.

In spite of the large amount of work which has already been done in the different States, amounting, as has been said, to nearly 160,000 square miles, the Bureau of Soils is annually confronted with an increasing number of requests for soil surveys, covering an increasingly large extent of territory. There are on file at the present time 478 requests for additional soil surveys, covering a total area of 495,290 square miles, located in 43 different States and Territories. The table on page 9 gives the number and source of these requests and the extent of territory which they cover.

Soil survey requests on file.

State or Territory.	Number of areas.	Total area.	State or Territory.	Number of areas.	Total area.
		Sq. miles			*Sq. miles.*
Alabama	16	14,339	Nevada	1	4,316
Arizona	1	6,147	New Hampshire	3	1,860
Arkansas	15	10,674	New Jersey	2	363
California	17	41,379	New Mexico	2	14,328
Colorado	2	2,608	New York	15	13,694
Delaware	3	1,960	North Carolina	27	14,638
Florida	15	18,069	North Dakota	2	7,562
Georgia	31	12,349	Oklahoma	8	7,250
Idaho	2	7,781	Ohio	4	1,980
Illinois	6	4,638	Oregon	8	26,255
Indiana	20	8,095	Pennsylvania	8	6,006
Iowa	5	3,216	South Carolina	21	17,736
Kansas	7	5,470	Tennessee	28	12,166
Kentucky	4	1,492	Texas	56	57,578
Louisiana	12	13,751	Utah	4	12,835
Maine	1	6,865	Vermont	1	783
Maryland	3	1,406	Virginia	23	8,526
Michigan	20	13,385	Washington	1	2,336
Minnesota	8	11,797	West Virginia	9	4,562
Missouri	28	16,746	Wisconsin	10	9,284
Mississippi	16	11,605			
Montana	5	40,276	Total	478	496,290
Nebraska	13	17,179			

The largest number of requests—56 in all—has been received from the State of Texas; the next largest number—31—from the State of Georgia, while 18 different States are represented by requests for the soil survey of 10 or more different areas. For several years it has been the experience of the Bureau of Soils that whenever the soil survey of any given area is completed and the report is published, this work has been sufficiently appreciated by people in surrounding areas to lead to almost immediate demands for the extension of the work in that vicinity.

It has also been the continuous experience of the Bureau of Soils that the number of requests received annually is increasing rather than decreasing. At the same time, with one or two exceptions, the funds and facilities for making these surveys have not been materially increased, with the result that there has been an accumulation of soil survey requests rather than a clearing up of those which are already on file.

There are at the present time on file at the office of the Bureau of Soils active requests for soil survey work which have been on file for periods of from three to five years and which up to the present time it has been impossible to satisfy.

In the distribution of the soil survey areas it has been the purpose of the Bureau of Soils not only to take under consideration the expressed urgency of the requests presented to the Bureau, but also the relationships of these requests and the location of the areas to be surveyed to the previous soil survey work of the Bureau and to the current distribution of parties in the same and contiguous States.

It has also been necessary, in order that the work of the survey may be continuous throughout the year, to distribute the parties with regard to the climatic conditions prevailing in different parts of the United States at different seasons in the year. On account of the severity of winter weather, field work can be conducted during the winter months in only a few of the most southern States. It has been necessary, therefore, during the three months of midwinter, to assign practically all of the soil survey forces to these most southern States.

It is equally necessary during the three midsummer months to assign practically the entire force to the more northern States. At the same time there is a larger number of States within which field work must be done in the summer time, if at all, than of southern States wherein field work may be carried on during the winter months. As a result there has been a somewhat larger proportion of field work in the Gulf States than in any area of equal size in the northern States. This has been emphasized in one instance by the cooperation of one of the Gulf States, which furnishes both funds and men to assist in soil survey work, and in which, consequently, the field work is progressing with considerable rapidity.

NEEDS OF THE DIFFERENT STATES.

In order to carry out the cooperative agreement with the State of Alabama, and in order to complete the soil survey of the entire State within the next four years' time, it is desirable that the sum of $10,000 annually should be expended in soil survey work in that State. This work is strongly requested by the Alabama Department of Agriculture, and the legislature of Alabama has provided a State fund amounting $10,000 a year for four years, in order to enable the State of Alabama to enter into such cooperation. A wide variety of soils and of agricultural interests and a lively appreciation on the part of the State officers of the necessity for developing these resources have brought about this desire for cooperation. It is recognized that the most secure basis for the agricultural development of the State consists of accurate soil surveys showing the character of each soil, its extent and capabilities. With the work in the State of Alabama once completed no further expenditures would be required for soil survey work in that State, and money thus appropriated for the next three of four years could later on be applied to similar work in other States.

For Arkansas there are soil survey requests on file which, if complied with, would cover the entire east-central portion of the State and a few areas in the southwestern section. These requests for soil surveys are filed by the State officers at the agricultural college and experiment stations and by prominent citizens of the different localities who desire the more complete development of the agricultural resources of the State. Not less than $2,500 should be expended on soil survey work in Arkansas during the coming fiscal year.

The requests for additional soil survey work in the State of California amount to insistent demands. These requests are presented by the Governor of the State, by numerous Representatives in Congress, by development and land associations, by associations of farmers and fruit growers, by boards of county officers, and by individual farmers. The subdivision of large tracts of land previously dry-farmed to grain, the completion of extensive and valuable Government irrigation works, and the even greater extent to which private irrigation works are being constructed, all lead to a general desire on the part of the officials and citizens of the State for detailed and accurate knowledge in regard to differences in characteristics of the soils and accurate advice in regard to the different kinds of fruit, vegetables, and other crops which may be produced. These requests also have been accompanied in many instances by an expression of the wish that the soil survey maps might be prepared upon a scale larger than 1 inch to the mile, in order that more detailed information might be given concerning the character of the soils and the presence or absence of alkali. The magnitude of the interests involved and the fact that these interests are directly those of new settlers as well as of present landowners would indicate that not less than $10,000 should be annually expended in increasing the amount of soil survey work done each year in the State of California.

Colorado contains probably a larger area of irrigated land than any other State in the United States. This land is made up of a large number of small areas in the mountain valleys which are scattered throughout the State. The soils, the climate, and the crop possibilities of these various areas differ widely within small geographical limits, and in order that accurate information concerning the soils may be obtained it is necessary to undertake a number of additional soil surveys, no one of which might be of great extent. It is also a fact that, owing to the character of crops produced under irrigation, the lands in Colorado have a high acreage value and also produce yields which give a large percentage of gain upon the investment. Under these circumstances the most detailed soil surveys should be made throughout the irrigated section of the State, and the number of these should be materially increased during the ensuing fiscal year, entailing a cost of about $3,500. In this connection it is the purpose of the Bureau of Soils ultimately to cover the Great Plains section of the State east of the Rocky Mountains with the reconnoissance soil survey which is being conducted in the dry lands region.

In the State of Connecticut only one soil survey has been made, covering the tobacco lands of the northern part of the Connecticut Valley lying within this State. In order that a greater knowledge may be obtained of the soils of the hill country throughout New England and of their relationship to orcharding and other intensive forms of farming, it is desirable that additional soil surveys should be taken up within the State at an early date. There also exist considerable areas of land situated in the southern portion of Connecticut well suited to trucking and market gardening industries, and soil surveys should be made in the Sound region of the State. This work could be adequately accomplished by the expenditure of about $2,000 during the next fiscal year.

There are on file at the Bureau of Soils urgent requests from State officers and prominent farmers of Delaware, as well as a series of resolutions passed by the State Grange, calling for the completion of the soil survey of the entire State. Changes in the agricultural condition of the State have convinced the leaders of agricultural thought that, owing to soil, climatic, and market conditions, the older general farming methods of the State should be to some degree abandoned, and that gradually the State should progress toward a specialization in the production of market garden, truck, and fruit crops. In order that such a development of the agriculture of the State may be systematically worked out and may follow the lines of easiest development, these State officers and prominent farmers have requested that a soil survey may be made of the entire State, to serve as a basis for additional work by the U. S. Department of Agriculture and for the work of the State College. The expenditure of about $3,500, preferably at one time or within the next few years, would complete the soil survey of the entire State of Delaware.

Although a considerable amount of soil survey work has been done in Florida, there are urgent requests for a great increase in the amount of this work each year. The work within the State thus far has been confined chiefly to the tobacco districts and to one trucking district. The development of other trucking areas within the State, the extension of the citrus groves, the reclamation of swamp lands, and the more thorough occupation of the lands in the western counties of Florida all require that additional soil survey work should be undertaken at an early date in order to furnish the citizens of the State, and others who may desire to settle there, with accurate information in regard to the soils of these different localities. The importance of this work would indicate that an expenditure of $3,500 during the ensuing fiscal year would not be excessive.

During the fiscal year ended June 30, 1908, the Bureau of Soils completed the work of making large-scale detailed maps of each of the agricultural high school farms in the eleven Congressional districts of Georgia. This work was done at the request of the Governor of Georgia and of other State officials. The same officials now request and desire that the detailed soil survey maps on the scale of 1 inch to the mile should be made of the eleven counties in Georgia within which the agricultural high schools are located, in order that the results of the experimental work conducted at these high schools may be applied immediately throughout the county surrounding each school. It is thoroughly appreciated by those having the agricultural development of the State and its educational facilities in charge that the value of the work of these schools will be largely increased if such soil surveys can be made at an early date. There are also other agricultural interests, including those of the tobacco growers in southwest Georgia, the fruit growers in central Georgia, and the rice and Sea Island cotton growers in eastern Georgia, that are urgently calling for the extension of soil survey work in these different localities. The amount of money expended in the State might well be increased to $4,500 or $5,000 annually in consideration of the valuable results which might be obtained during the next few years.

The Bureau of Soils has made soil surveys of several irrigated areas in the State of Idaho, and during the fiscal year ended June 30, 1908, one of the Minidoka reclamation project in southern Idaho. In addition to the United States reclamation tracts, there are a large number of private irrigation projects under way under the provisions of the Carey Act. Numerous requests have been received from Idaho for additional soil survey work in this connection, and the development of the agricultural interests of the State would be well served by the expenditure of not less than $2,500 annually on soil survey work during the next few years.

Although a considerable amount of soil survey work has already been done in Indiana, there are on file at the present time requests for a larger number of different soil survey areas than have already been completed in the State. For the most part these requests come from the northern part of the State, the proximity of which to great city markets has awakened the people of that section to the desirability of producing vegetable and other crops for sale at such centers. Requests for soil surveys in northern Indiana come not only from the citizens of that section of the State, but are also on file from the city of Chicago, where individuals and the city authorities are interested in the development of market garden lands within reasonable distances from the Chicago markets. There are also requests for soil surveys to be taken up in connection with the drainage of additional areas of swamp land within the State and their occupation for agricultural purposes. About $3,000 annually should be expended on soil survey work in Indiana during the next few years.

The Iowa State College of Agriculture has requested that the Bureau of Soils should undertake the survey of additional areas within the State as soon as possible in connection, first, with the extension of the fruit industry along both the Mississippi and Missouri rivers, and in certain sections of the State in connection with the drainage of valuable swamp lands. It would be desirable to spend not less than $2,500 during the next fiscal year in the prosecution of this work.

In the case of Kansas there are several requests for detailed soil surveys in the eastern part of the State, and it is proposed to extend as soon as possible the reconnoissance soil survey of the Great Plains section to cover all of the western part of the State.

Additional soil surveys are requested both in the export-tobacco section of western Kentucky and in the " bluegrass region " of central Kentucky; and as only a small amount of work has been accomplished within the State, it would seem desirable from every standpoint to extend this work, not only for the direct benefit of the residents of the State of Kentucky, but also in order to aid in the completion of certain details in general soil classification which can be worked out within the limits of the State. About $2,000 would meet the requirements of this work during the coming fiscal year.

In the State of Louisiana the State Agricultural College and Experiment Station officials have requested the Bureau of Soils to pursue a continuous policy in the location of soil surveys. These State officers hold local conditions in mind, and have requested that as rapidly as possible a set of parish surveys should be extended across the northern end of the State, in order to outline the variety and extent of the soils of that section, which is rapidly being denuded of its timber, and where the land is being offered for agricultural occupation. There are a variety of agricultural products suited to the soils of this section of the State which may be introduced as soon as the existence of the proper soils has been shown. It would be possible to extend the cultivation of rice to the northern boundary of the State. There are also excellent opportunities for the production of truck crops and probably of the Cuban type of filler tobacco. In addition the State officials desire the completion of a similar series of soil surveys extending north and south through the central portion of the State, in order to give as rapidly as possible an outline of the soil conditions of the entire State, as a basis for additional experimental and demonstration work on the part of the State College and Experiment Station. Taking these facts into consideration, it would be well to expend not less than $4,000 nor more than $5,000 annually for the prosecution of soil surveys within this State. This is especially desirable because of the fact that large bodies of swamp land should be investigated, and when their agricultural possibilities are determined and made known this land can be sold by the State, drained, and taken up for private occupation. Not only are the interests of individuals concerned, but the direct interest of the State as an organization is concerned in the prosecution of this work.

Soil survey work has been begun in the State of Maine, and there are requests on file for the continuation of this work. The officers of the State college of agriculture desire that soil survey work should at once be begun in the vicinity of the college of agriculture and the experiment station, and that as rapidly as possible this soil survey work should be extended through the southern agricultural portion of the State, in order to serve as a basis for the plans for the improvement of agricultural conditions which are being worked out by the State college of agriculture. Not less than $2,500 a year should be expended in this work, in order to meet the desires and urgent requests which have emanated from private individuals and State authorities.

In Maryland soil survey work has progressed with reasonable rapidity in connection and in cooperation with the work of the Maryland Geological Survey. The officers of this survey request that not less than one county shall be covered by the soil survey each year, in order that the results secured may be embodied in the Maryland Geological Survey's reports upon the geology and economic resources of the counties of the State. The survey of two additional counties has been represented to be desirable, and during the ensuing fiscal year not less than $2,000 should be expended in this work. The areas in the State of Maryland have been systematically distributed in connection with the progress of State investigations of the other economic resources.

Numerous inquiries in regard to soils in different portions of the State of Massachusetts and several requests for additional soil surveys would indicate that additional areas should be taken up within that State at an early date. In connection with the general problem of the rehabilitation of certain farm lands extending throughout the New England States soil surveys should be made in western and in east-central Massachusetts to determine the capabilities of these soils for the production of fruit and market garden crops. Not less than $1,500 should be expended during the ensuing fiscal year in the prosecution of this work in Massachusetts.

There are on file numerous requests for additional soil surveys in the State of Michigan, not only to meet general agricultural requirements, but particularly to extend the work which has already been begun in the investigation of the sugar-beet soils of eastern and southern Michigan. It is also desirable to determine the agricultural possibilities of large tracts of land in central and northern Michigan, which were occupied by forest and which are now known to contain considerable areas of soil suitable for agricultural occupation, interspersed with other bodies of soil that could not well be occupied as farm lands under any of the present conditions of agriculture. These cut-over timber lands in north-central and northern Michigan constitute a portion of an extensive problem in the Great Lakes region. It has already been demonstrated by the Michigan College of Agriculture and by individual farmers in this region that a considerable proportion of the sandy loam lands of this section can be occupied for the production of potatoes and other valuable special crops. It has also been demonstrated that these valuable farm lands are intricately associated with others which are practically worthless for agricultural occupation at the present time. It is recommended that not less than $4,000 should be expended during the ensuing fiscal year in making detailed soil surveys within the State of Michigan, in order to meet these reasonable requests of individuals and State officers.

Similar problems exist in Minnesota over possibly a larger area than in Michigan, and in addition there are swamp lands throughout the north-central part of the State which when properly drained might be occupied for the production of crops. There are urgent requests for a considerable extent of work in northern Minnesota, as well as for the prosecution of soil survey work in other parts of the State in connection with the agricultural high schools and the well-conducted attempt on the part of the State to systematize and promote agricultural interests generally. Work of this character now in progress would be greatly aided and supported by the extension of soil survey work, and not less than $5,000 should be expended during the ensuing fiscal year for the extension of soil survey work in Minnesota.

The soil surveys already completed in the State of Mississippi have been so favorably received that there is an insistent demand for a considerable extension of the work within the State. In the southern part the detailed soil surveys are requested in order to determine the extent and character of the cut-over timber lands, their relationship to soils along the Gulf coast, and, through establishing that relationship, their adaptability to the production of various staple and special crops. Some of the soils of this section have long been considered popularly to be worthless for agricultural purposes and only valuable when reforested, but the soil surveys already made in this section have shown that the greater part of the soils of southern Mississippi are well suited to the production of truck crops, of cotton, and of certain forage crops, and that these crops are grown to advantage on the same soils in other parts of the Gulf Coast. In order that the extent of these different agricultural soils may be made known to the citizens of Mississippi and of the remainder of the United States, and that their value may be properly appreciated, soil surveys have been requested in practically all of the southern Mississippi counties. Similarly, the soil surveys in northern Mississippi have shown the existence of large bodies of prairie soils especially adapted to the economical production of alfalfa, and it is known that these prairie soils are practically the last low-priced prairie soils existing in the United States. Numerous inquiries in regard to the extent and capabilities of these soils are annually received at the Bureau, and the citizens of Mississippi have requested that as rapidly as possible surveys should be made in this section, in order to give detailed information in regard to these soils. Not less than $5,000 should be expended for the purpose of making detailed soil surveys in the State of Mississippi during the ensuing fiscal year.

A large number of requests for soil surveys in the State of Missouri are on file. The authorities of the State college and experiment station desire cooperation with the Bureau of Soils in the prosecution of this work, which cooperation the Bureau has been unable to undertake up to the present time. In order that such cooperation may be entered into and that the soil survey work may be pushed within the State of Missouri, not less than $5,000 annually should be expended in this State upon detailed soil survey work.

In Montana the work of the reconnoissance survey will be undertaken in the eastern part of the State at an early date. There exist throughout the State a large number of irrigated valleys and of others which are capable of irrigation both under the Federal reclamation works and under the provisions of the Carey Act. In order that these detailed soil surveys might be made in addition to the reconnoissance work, about $1,500 should be expended during the ensuing fiscal year for this purpose within the State.

Similarly the work of making the reconnoissance soil survey in western Nebraska will be undertaken in the near future. The officers of the State college of agriculture and experiment station have requested a systematic extension of the detailed soil survey work in the eastern and central portions of the State, and about $3,000 should be allotted to this work during the next fiscal year.

In Nevada soil survey work has been assigned in connection with the Government reclamation projects of the Truckee-Carson area, and it is desirable that in the near future additional detailed work should be taken up in sections of the State newly opened to settlement by the extension of railroad facilities. There are considerable tracts of land within the State which are not only capable of development through the methods of dry-land agriculture, but also additional areas which may be irrigated either through Government works or private enterprise. The development of the State would seem to require the extension of its agricultural interests over all of the lands which are capable of crop production. In order that the soil survey work may thus be extended, it would seem desirable during the ensuing fiscal year to spend not less than $2,000 in the soil survey work in Nevada.

Requests for additional soil survey work in New Hampshire cover three of the southern counties. This work has been undertaken in New Hampshire at the request of the authorities of the State college of agriculture, and it is their desire that the survey should be pushed as rapidly as possible in order both to give a basis for the agricultural development of the State and to give information for the State Forester which may be used as a basis for the reforestation of considerable portions of the hill lands of the State. Not less than $2,000 should be expended in New Hampshire during the ensuing fiscal year.

In New Jersey additional soil surveys should be made in the northern portion of the State in behalf of the fruit interests of that section. None have been undertaken in that part of the State. The sum of $1,500 should be made available for this work.

Recent agricultural developments in southern and southeastern New Mexico indicate that there are large bodies of land which under private irrigation systems may become valuable agricultural territory. In order that a further knowledge of these lands may be obtained and made public, it is desirable to expend about $2,000 in soil survey work in New Mexico at an early date.

The State college of agriculture of New York has requested direct cooperation with the Bureau of Soils, in order to make a complete detailed soil survey of the State at the earliest possible date. The State authorities, in order to increase the rate of progress, are assisting in this work by furnishing both men and money. In addition to the general value of the soil surveys common to all sections, the New York State college of agriculture is using this soil survey work directly as the basis for horticultural and agricultural surveys conducted solely by the State. In order that proper progress may be made in New York State, not less than $5,000 should be expended upon soil survey work in that State during the next fiscal year.

Similarly the State of North Carolina is directly cooperating with the Bureau of Soils through the North Carolina Department of Agriculture, furnishing both men and funds to expedite the progress of soil survey work in the State. In addition to the general information furnished by the soil surveys, the State Department of Agriculture is establishing branch experimental farms for testing varieties of crops, the effects of different fertilizers on different soils, and the best methods of soil management in such regions as have been covered by soil surveys. Work is now in progress in the bright tobacco districts of the central and eastern parts of the State and will be taken up in connection with the development of the trucking industry along the Atlantic coast, the general farming development of the Piedmont section, and the fruit interests of the mountain and valley regions. In order that this work may adequately meet the urgent demands for additional soil survey work in North Carolina, not less than $5,000 should be expended in the State during the ensuing fiscal year and annually until the soil survey of the State is completed.

Again in North Dakota the State Agricultural and Economic Survey is contributing both men and money to facilitate the progress of soil survey work. This work is in such demand that where State funds are inadequate popular subscriptions within the area to be surveyed have supplied the State fund invested in this class of work. The reconnoissance soil survey work of the western half of the State was begun during the field season of 1908. Additional detailed soil surveys should be made throughout the eastern section, to meet the demands from county officers, agricultural organizations, and the State authorities. These soil surveys, in addition to their ordinary agricultural uses, are also being used as a direct basis for appraising land values and assessing land taxes in several of the counties in the State. The survey thus serves the double purpose of supplying agricultural information to all concerned and of furnishing the assessors of the different localities with an accurate basis for adjusting land values and tax rates. Not less than $2,500 should be expended in additional soil surveys in North Dakota during the ensuing fiscal year.

Additional soil surveys should be made throughout the northern part of Ohio, in order to define and extend the "grape belt," which is typically developed in western New York, northwestern Pennsylvania, and northeastern Ohio. These grape soils have been studied in both New York and Pennsylvania and in one county in Ohio, and it is known that they extend farther to the westward than they have yet been mapped. For general farming purposes these soils have a value of $60 to $70 an acre. As grape soils they have a value of $250 to $350 an acre, and detailed soil surveys should be made in order to locate these grape soils throughout the extent of their existence in northern Ohio. It will also be desirable to complete additional surveys in western Ohio, to outline the areas of valuable swamp land which are being drained and will be drained more completely in the near future. For these purposes not less than $2,500 should be expended during the ensuing fiscal year.

Two soil surveys have already been made in the new State of Oklahoma, and there are on hand requests for a large amount of additional work. In order that the agricultural resources of the State may become better known, it is desirable that a considerable amount of soil survey work should be undertaken within the State at once. The existence of valuable fruit lands, of excellent alfalfa lands, and of soils suited to the production of nearly all staple crops is known in a general way. The area and extent of soils of the different classes suited to the production of these different crops should be definitely outlined by detailed soil surveys, and for this purpose not less than $3,500 should be devoted to the work in Oklahoma during the next fiscal year.

Only two small areas have been surveyed in the State of Oregon. The extension of railroad facilities within the State, the known existence of extremely valuable fruit soils, the extension of private and Government irrigation works, and the desirability of subdividing extensive grain ranches into more intensively farmed tracts all point to the necessity for a considerable extension of the soil survey work within the State. Not less than $3,500 should be expended within the State of Oregon during the ensuing fiscal year for the purpose of making these soil surveys.

The Bureau of Soils has been urgently requested by the dean of the Pennsylvania State college of agriculture to continue detailed soil survey work in the State of Pennsylvania as rapidly as possible, and to undertake the work of the Appalachian reconnoissance survey in the central and western part of the State as funds permit. The requests of this State officer are supported by similar requests from the State horticultural society and from county horticultural organizations. Probably the largest demand for soil survey work in any of the eastern States comes from Pennsylvania at the present time. In order that the detailed soil survey work may meet the requirements of the different State agricultural officers, not less than $5,000 should be expended during the ensuing fiscal year in soil surveys in the State. It will also be desirable to increase the amount of money allotted to the Appalachian reconnoissance survey, in order that the entire western portion of the State of Pennsylvania may be covered by this survey at an early date.

The detailed soil survey of Rhode Island has already been made, and no further funds will need to be expended upon this work in that State.

A request is on file from the State college of agriculture of South Carolina that a competent soil expert should be permanently assigned by the State, in order that the progress of the soil survey work may be uninterrupted. Requests are on file also at the Bureau of Soils from various sources for the survey of all but four counties within the State. In view of this broad general interest in soil survey work and of the prospects of its immediate utilization by the citizens of South Carolina and by their local agricultural institutions, it is recommended that not less than $5,000 should be expended for detailed soil survey work within the State during the next fiscal year.

There are no urgent requests for detailed soil surveys from the State of South Dakota, but there are a large number of inquiries from persons outside of the State of South Dakota in regard to the character of soils and the agricultural possibilities of the soils of the State, and in order that the Bureau of Soils may be in a position definitely to answer these inquiries additional detailed soil survey work should be taken up in the State. It is also proposed to extend the semiarid reconnoissance soil survey into the western portion of the State at an early date.

An average amount of detailed soil survey work has been completed in the State of Tennessee, and requests are on file at the Bureau of Soils for such surveys in approximately one-third of the remaining counties of the State. The agricultural development of the Highland Rim, the Cumberland Plateau, and the mountain regions of the State would be greatly aided by the prosecution of this work, and it is recommended that not less than $2,500 should be appropriated for this work during the next fiscal year.

Although a large amount of detailed soil survey work has been completed in the humid region of the State of Texas, this amount is relatively small compared with the total area of the State. Existing agricultural conditions, owing to the ravages of the cotton boll weevil and of the green bug, have caused urgent requests to be presented to the Bureau of Soils for detailed soil surveys in practically all of the northeastern part of the State. The teaching of agriculture has also been made compulsory in all of the rural schools of the State, and the State educational authorities, the Farmers' Congress, and local commissioners of education have requested additional soil surveys, to form a basis for the soil instruction in the entire public school system of the State. Considerable sums have already been expended in the making of such soil surveys, but an additional sum of $10,000 should be made available for this work in the State of Texas during the ensuing fiscal year.

The completion of additional railroad facilities in various parts of the State of Utah has rendered accessible considerable additional areas of agricultural land, and there are requests on file for new detailed soil surveys in several parts of the State. It would be desirable to expend not less than $2,000 in meeting these requests during the ensuing fiscal year.

The State of Vermont shares with the remaining New England States the desire for additional soil surveys to assist the State organizations in their efforts to improve agricultural conditions. The problems are the same as those of the other northeastern States, and $2,000 should be provided during the next fiscal year for additional soil surveys in Vermont.

The director of the State Agricultural Experiment Station in Virginia requests additional soil survey work, particularly in the western part of the State, at the earliest possible date. In addition there are a large number of requests from various sources for more detailed soil surveys throughout the State. There have also been received at the Bureau of Soils many requests for information concerning the soils and soil resources of all parts of Virginia from correspondents located in other States. In order that all of these requests for soil surveys and for soil information may be properly met, not less than $3,500 should be expended in Virginia for making detailed soil surveys during the next fiscal year.

The investigation of the extensive tracts of timber lands which are being cut over at the present time in the State of Washington, a study of a number of important irrigated districts and a study of the non-irrigated lands in the eastern part of the State should be undertaken at an early date through detailed soil surveys. About $2,500 should be expended on these projects during the next fiscal year.

The West Virginia Geological Survey is cooperating with the Bureau of Soils and paying all of the field expenses of the Bureau's soil experts in connection with soil survey work within that State. The different counties are being systematically surveyed, and the results of these surveys are being published in the form of maps and reports by the West Virginia Geological Survey and by the Bureau of Soils. The amount of money needed for the continuation of this work in West Virginia would all be expended in the salaries of the Bureau experts assigned to the State, and the sum of $1,600 annually is required in order to maintain this work upon a satisfactory basis.

Soil surveys have been requested in the northern portion of Wisconsin in order to determine whether the soils of that section are suitable to apple orcharding and, if such soils exist, to show their definite extent and location. Surveys were also requested for a considerable number of counties in central Wisconsin, where it has been shown that there are large tracts of agricultural land existing in the old forest belt which has been cut over. In order to meet the requests on file at the present time at the Bureau of Soils, about $3,000 should be expended in detailed soil surveys in the State of Wisconsin in the ensuing fiscal year.

Additional soil surveys should be undertaken in Wyoming in connection with the Federal reclamation tracts and with those which are being developed by private parties under the provisions of the Carey Act. There are numerous small areas of irrigable soils well suited to agricultural occupation within the State, and about $2,500 should be spent during the next fiscal year in making detailed soil surveys of a number of these tracts.

RECONNOISSANCE SOIL SURVEYS.

There are certain sections of the United States in which the agricultural interests at the present time are not strongly developed and where the soils for the greater part are used either for forestry, for grazing, or for other extensive forms of agricultural occupation. In these sections the population is sparse, the soil resources of the regions are but little known outside of the localities, and a considerable amount of preliminary exploratory work will be necessary before the general public can become aware of the numerous opportunities for agricultural occupation which actually exist. Within these regions it is not considered desirable at the present time to undertake detailed soil surveys, but all of the essential facts in connection with these soils and their agricultural possibilities can be ascertained through reconnoissance surveys of such sections. In order that the total soil resources of the United States may be investigated in the most economical manner possible, with the least expenditure of time and money, and with a degree of detail which is suited to the conditions which are liable to prevail for several years, it is recommended that additional funds should be appropriated for increasing the rate of work in the reconnoissance soil survey of the Great Plains region and for the reconnoissance soil survey of the Appalachian Mountain and Plateau region. It would also be desirable to appropriate a specific fund for a similar reconnoissance survey of the cut-over timber lands of the Great Lakes region and soils suited to dry-land farming in the Great Basin region of Utah, Nevada, and other western States.

SOIL UTILIZATION.

For the fiscal year 1908 the work of soil management and of the investigation of alkali soils were combined and administered as the work of Soil Utilization. To these lines of work, as previously carried on, were added the investigation of certain extensive soil series and the reconnoissance soil survey of the soils of the Appalachian region and the reconnoissance soil survey of the soils of the humid region of Texas.

Numerous lectures were also given by the soil experts of the Bureau upon the results of the soil survey work, and in a few instances soil experts were stationed in localities where a considerable amount of soil survey work had been completed, to call attention directly to the results of these surveys and to assist the farmers and direct them in the practical application of these results on the soils which they were cultivating.

By the direction of the Secretary of Agriculture this work of Soil Utilization was discontinued in the Bureau of Soils at the close of the fiscal year 1908.

SOIL IMPROVEMENT IN NEW YORK AND PENNSYLVANIA.

The further investigation of soils in central and southern New York, examined during the progress of various county soil surveys, was undertaken in order to determine the general extent and location of the soils of the Volusia series both in New York and in Pennsylvania. The soil type known as the Volusia silt loam covering the upland portion of central and western New York and northern and northwestern Pennsylvania has been so abused by careless methods of soil management, or the actual uses of the soil have been so misunderstood, that the type is marked throughout its extent by farms which have decreased in agricultural value for the last twenty-five years, and by the actual desertion of these farms so far as active agricultural operations are concerned. The Division of Soil Utilization not only investigated the extent of these soils during the fiscal year ended June 30, 1908, but also as a result of these investigations determined methods of soil management which had been proved to be effective in increasing the producing capacity of these soils. In Cayuga and Tompkins counties, N. Y., arrangements were made with nearly sixty cooperating farmers who agreed to accept the advice of the soil experts of the Bureau of Soils and to follow it in every detail in the plowing, tilling, manuring, and general soil management of small tracts upon their own farms. This work was carried out to June 30, 1908, and excellent results were secured in every case where the advice of the Bureau of Soils expert was followed.

SOIL MANAGEMENT IN DELAWARE AND MARYLAND.

In the same way soil survey work in the Maryland-Delaware peninsula, between the Chesapeake and Delaware bays, was followed up by the assignment of a soil expert who undertook to instruct the farmers of that section in the preparation and treatment of their different types of soils for the production of different crops especially suited to those soils. Excellent results were obtained in all of the cases where this expert's advice was sought, secured, and followed out. In one instance the yield of corn was increased from a previous average of 12 bushels an acre to a yield of 62 bushels per acre during the fiscal year 1908. The advice of this expert was also given in the selection of over 300 acres of soils suitable for the production of different varieties of strawberries, and this area was actually planted in southern Delaware as a result of the advice furnished by the soil expert. Other results of the same character were obtained within the State, and a general interest in more diversified farming and particularly in the use of each soil for its appropriate crop was awakened. Other soil probelms chiefly connected with the maintenance of soil fertility were also investigated, and the results of the investigations were made known and applied by the soil expert in charge of this section.

APPALACHIAN RECONNOISSANCE.

The general reconnoissance of the Appalachian Mountain and Plateau region was begun under the direction of the Division of Soil Utilization in the form of a reconnoissance of the fruit soils of that section.

SOIL MANAGEMENT IN SOUTH CAROLINA.

In order that the results of soil surveys in central South Carolina might be directly and explicitly interpreted to the citizens in several of the adjoining counties covered by these surveys, a soil expert was detailed to these counties at the request of local farmers' organizations and chambers of commerce. This expert gave personal advice in regard to the preparation and handling of soils and the selection of the appropriate crops for the different types of soils in the three counties of Lee, Sumter, and Orangeburg.

SELECTION OF TOBACCO SOILS IN FLORIDA, GEORGIA, AND ALABAMA.

Since 1903 the Bureau of Soils has been making detailed soil surveys of the region suited to the production of shade-grown wrapper tobacco in Florida, Georgia, and Alabama. At the request of numerous tobacco growers and of persons wishing to engage in the cultivation of this grade of tobacco, a soil expert from the Bureau of Soils was detailed to the general region in order to advise with tobacco planters concerning the safe extension of tobacco culture upon the soils known to be adapted to this grade of tobacco in the three States mentioned. Owing to the large amount of money which must be invested in the construction of the shade and tobacco barns, and owing also to the fact that the production of this crop upon any of the soils is new in the agricultural practice of the region, it was found necessary to give the most explicit advice in regard to the selection of soil, since even within those soil types which are generally well suited to the production of shade-grown tobacco there are certain tracts which owing to the depth of the surface soil and the peculiarities of subsoil drainage are better suited than other portions of the same type to the production of this delicate cigar wrapper leaf. It is not simply a question as to whether the soil will produce the tobacco, but in addition a question as to whether the wrapper tobacco will be of such exceptional grade as to bring the highest market prices and therefore adequate profit to the grower. Not only is great care necessary in the selection of this soil, but also new methods of soil management in the preparation, fertilization, and cultivation of the land must be taught to farmers and communities of farmers who are only familiar with the less exacting methods of soil management required for the production of cotton and the other staple crops. In order that this industry might be firmly established in additional counties in Florida, Georgia, and Alabama, a soil expert particularly familiar with these soils and their methods of management was assigned to the region, to advise directly with such tobacco planters as might need his services. A continuation of this work has been strongly demanded by tobacco growers in all three States.

SOIL UTILIZATION IN ALABAMA.

Similarly in the State of Alabama the numerous soil surveys which had already been completed through the central portion of the State had shown the existence of considerable areas of "black prairie" lands well suited to the production of alfalfa, of areas of the Orangeburg series of soils well suited to the production of the cigar filler tobacco, and in addition several fundamental problems in the preparation and treatment of soils for the production of these two crops and also of the great staples cotton and corn. In response to urgent requests from the Representatives of the State in Congress and from the State department of agriculture, as well as from citizens of the State, a soil expert was assigned to central Alabama to undertake personal advice and explanation to the farmers of that general region in connection with these soil problems. During the fiscal year ended June 30, 1908, over 2,500 requests for the advice of the soil man were received and turned over to this soil expert, and his personal attention was given to over 500 of these requests, while he answered through the mails or in the form of articles published in the local press the general questions submitted in practically all other communications.

SOIL UTILIZATION IN MISSISSIPPI.

In the same way the requests for the detail of a soil expert to a region in northeastern Mississippi presenting the same problems as those of central Alabama were complied with during the last months of the fiscal year ended June 30, 1908. The duties of this soil expert were only begun during that fiscal year.

RECONNOISSANCE SOIL SURVEY IN TEXAS.

In response to a request from a great body of progressive farmers in the State of Texas, presented in the form of resolutions adopted at the Farmers' Congress, a soil expert from the Bureau was assigned to that State to make a reconnoissance investigation of the soils of the humid portion of the State, in order that the report thus prepared might be made available at once for use in connection with the agricultural instruction required by law in all of the rural schools of Texas. This work was practically completed by June 30, 1908, and this preliminary report is ready for publication, but should be supplemented by further investigations along the same line throughout the entire extent of the State.

FRUIT SOILS IN TENNESSEE.

In connection with the soil surveys which have been made in central Tennessee, and which have developed the existence of extensive areas of soils well suited to the production of peaches, cantaloupes, and other fruit and truck crops, the farmers of this portion of the State requested that a soil expert should be assigned to that section of the State to advise with the community in regard to the preparation, fertilization, and management of these different soils suited to these different crops. These industries are just gaining a foothold in that portion of the State, and the existence of considerable areas of soils suitable to their extension has been shown by the detailed soil surveys of the Bureau of Soils. During the initial stages of the development of these industries, the farmers of this region have requested the continued detail of a soil expert to aid them locally in the solution of the various new problems in soil management which are presented by this change in the general agricultural practice of the region.

SOIL UTILIZATION IN CALIFORNIA.

The breaking up of extensive wheat ranches in the San Joaquin and Sacramento valleys, California, and their subdivision for cultivation under conditions of intensive farming, brought about by the irrigation of considerable tracts, caused numerous county and local organizations of farmers throughout these two valleys to petition the Bureau of Soils for the assignment of a soil expert to that region, who should give practical advice to the farmers in regard to the proper preparation, fertilization, cultivation, and special features of management of these soils under the new agricultural conditions. The different soils within the region require different amounts of water applied at different times and by different methods of irrigation. Certain soils which can not be economically irrigated can be so tilled that the natural rainfall may be stored within the soil for the benefit of the crops, and the services of a soil expert were required to determine the peculiar moisture characteristics of each particular soil and the methods of soil management best suited to the maintenance of the optimum moisture conditions under different conditions of soil texture and soil management. In addition, there were extended areas of land, which had previously been considered of little value on account of their liability to overflow, along the lower courses of both the Sacramento and San Joaquin rivers. The proper management of these soils, in order to render them capable of agricultural occupation, was also one of the problems assigned to the soil expert detailed to that region. As a result of the efforts of this soil expert the actual capabilities of thousands of acres of land in the great central valleys of California were made known to the owners of this land and to intending settlers upon this land, and the methods of treatment required by the different types and classes of soils were carefully worked out by this soil expert through his knowledge of soil properties in general and of the methods of soil management which had been successfully employed upon the same types and classes of soils in other portions of California and in other irrigated regions in the United States. As a result of the advice of this soil expert for a single year, hundreds of acres of overflow land not before considered available for cultivation have been rendered so available and in part have already been profitably occupied.

INVESTIGATIONS OF GREENHOUSE SOILS.

Numerous requests are received each year at the Bureau of Soils for advice in regard to the preparation, fertilization, cultivation, and management of soils upon greenhouse benches in all parts of the United States. This highly specialized form of soil science has never been thoroughly investigated by any branch of the U. S. Department of Agriculture, and in order that this important work might be taken up a soil expert from the Bureau of Soils was detailed to visit a number of greenhouses in order to investigate the properties of the different soils used in the production of highly valuable greenhouse crops, the special forms of preparation which each of these soils must undergo, the sources from which the proper soil might be obtained, the methods of fertilization appropriate to each, and the optimum moisture content for each, in order to produce the most successful results. This work was begun in the fiscal year ended June 30, 1908.

LABORATORY WORK.

SOIL FERTILITY INVESTIGATIONS.

A noteworthy advance has been made during the year in the investigations to determine factors in soils causing low crop production, and it has been possible to obtain a broader view of the effect of organic remains and to form a clearer conception of the manner in which these function in the soil.

Extended investigations have been carried on with infertile soils in determining the presence of toxic substances and in identifying and isolating these bodies. The properties of these and related compounds likely to occur in soils have been exhaustively studied with reference to their effect on crops, and much valuable information concerning the processes of decay of organic matter in soils obtained. Investigations into the origin of these substances and the conditions which lead to their formation have been made, i. e., whether they are formed by the accumulation of root excreta in a soil not able to eliminate them by natural processes of destruction or decay, whether they are the products of germination, or of bacterial and other life processes within the soil, or whether they are formed by the decomposition of vegetable matter under unfavorable soil conditions. These various problems in soil fertility have been studied and methods of investigating them developed. The results already obtained will, it is hoped, help to unravel the more intricate problems of the soil and in the end furnish a basis for rational agriculture.

Another important line of investigation has been the study of the conditions which will prevent the formation of these toxic bodies and of treatments which will modify or destroy them, rendering them harmless to crops. Among the subjects studied has been the action of fertilizers, the action of plant roots, the effect of cultivation, with its resulting aeration and oxidation, the influence of crop rotation, and the action of nonplant-food substances.

Other lines of work which have been prosecuted during the past year have concerned themselves with the time action of fertilizers, the oxidizing powers of roots and the influence of fertilizers thereon, the action of nitrates in overcoming toxic conditions, the effects of climatological factors on the products of plant life in the soil, and the action of fertilizers in this connection, and also the effects of the organic matter of stable manure and the processes of oxidation and decay involved in green manuring.

The productiveness of a soil depends largely upon the condition of the organic matter in the soil and the processes which are at work in destroying the plant remains or other organic substances. Several toxic bodies have actually been isolated from soils during the past year. They are definite chemical compounds, having a characteristic crystalline structure.

Regarding the origin of these bodies, it has been definitely shown that toxic substances arise as the result of plant growth. Toxic conditions arise if certain substances from plants accumulate in the soil. When the majority of soils are kept in "good tilth" by cultivation and suitable rotation of crops, these toxic substances will not accumulate to an extent which will be harmful. But when one crop follows another of the same kind, especially in soils in poor physical condition, the substances do accumulate to a harmful degree. During the decay of plants in the soil a large number of organic compounds are formed, and under unfavorable soil conditions they may give rise to toxic substances. Since it has been demonstrated by these studies that toxic bodies are converted into nontoxic bodies by oxidation it may therefore be understood readily how processes augmenting soil aeration improve soil conditions. When the soil is saturated with water or is so packed that a sufficient supply of air is not afforded, the vegetable matter may be imperfectly decomposed, producing toxic substances which temporarily impair the productivity of the soil. When, however, the soil is in the proper physical condition, it is possible for the beneficial changes known as "humification" to proceed.

It has been further shown that the roots of plants have a great oxidizing power and are able to act upon the toxic organic material in such a way that its toxic properties are lost. This oxidizing power is greatly affected by many salts, and among these salts those commonly used as fertilizers are among the most efficient. The large amount of root surface which plants possess renders this oxidizing power important in its bearing upon soil conditions, upon fertilizer applications, and especially upon the destruction of toxic conditions through crop rotation. These facts are of distinct value in the study of soil and fertilizer problems.

An important feature in connection with these investigations has been the development of new methods in agricultural research, which has made it possible to attack the more intricate problems of the soil. With the methods developed, the laboratories have been engaged in the examination of the nature of the organic bodies causing infertility in soils from various States, covering a wide range of soil types and varied conditions of farming, including cotton soils, wheat soils, flax soils, truck soils, corn soils, and grass soils. In connection with these general investigations several specific cases of wide importance have been studied, notably the condition of certain soils devoted to potato culture in California, where the yields have rapidly fallen off. An examination of these soils has shown, among other things, that fundamental changes have taken place in the character of the organic matter under successive croppings, and the character of these changes has been worked out in part and is at present under further investigation. Using these same methods, some of the laboratory force have been doing valuable work at the Pennsylvania Agricultural Experiment Station, where they have been detailed to take up the study of certain problems connected with plot fertilizer experiments that have been running for over twenty-five years.

PHYSICAL AND CHEMICAL INVESTIGATIONS.

During the last fiscal year the Bureau of Soils has made mechanical analyses of about 2,000 soils for the use of the Soil Survey of the Bureau. It has made upward of 800 chemical examinations of soils for the field parties of the Bureau, and about 4,500 chemical examinations of soils, drainage waters, and fertilizers for other Bureaus and outside parties entitled to such assistance. The Bureau has devised several new forms of apparatus and new methods for the analysis of soils, descriptions of which have been given in appropriate places in literature. Besides this routine work, the laboratories have continued investigations upon the fundamental properties of soils. The absorption of vapors, especially water vapor and carbon dioxid, has been thoroughly investigated, as well as the absorption of dissolved substances from solution, properties of the utmost importance as affecting the physical condition of soils. The retention of soluble fertilizers and the reclamation of soils "affected by alkali" have been studied, and the investigations which have been carried on for some years past by this Bureau and the results obtained by other investigators in these lines of investigation throughout the world have been brought together and made available for scientific workers in two bulletins of this Bureau. Work has been continued on the closely related subjects of flocculation and sedimentation, with results which throw light not only on the physical structure and arrangement of the soils but also on the nature of flowing waters and soil wastage, etc., and the investigation of this subject is now being actively continued.

It has been shown that practically all the physical properties of a soil encountered in practical soil management can be correlated with the moisture content, and that there is a definite moisture content for each soil at which these physical properties are either at a maximum or at a minimum, and that it is this critical moisture content, or optimum moisture content, at which the soil can be put into its best physical condition for the growth of plants. It appears that the optimum water content of a soil, supposed to be a physiological factor, varying with the different plants, is in fact a physical factor of the soil alone, and for any given soil varies little if any with ordinary field crops. The relation between this critical water content and the free water and film water in the soil has been clearly demonstrated and for the first time put on a sound theoretical basis. The practical value of this work in relation to time and methods of cultivation has been shown and the results have been published.

The effect of external agencies on the soil has been studied by both laboratory and field observations. The translocation of soil material by the wind has received especial consideration, from the point of view both of its destructive effects upon cultivated fields and of the determination of the heterogeneous character of the mineral components of soils. An extensive and widely scattered literature on this subject has been brought together and coordinated and a publication prepared giving a comprehensive and complete résumé of our knowledge of this subject. The erosion of soils by water as well as wind has been studied and is now being actively investigated. It has been shown that the factors affecting the erosivity of a soil are external rather than internal, but speaking generally there are no inherent characteristics of a soil itself which would cause it to erode more in one locality than in another, and the widely known differences observed in different areas are the results of climatic agencies and faulty methods of cultivation rather than inherent properties of the soils themselves.

Among the external agencies affecting soils and their power of crop production is the important one of heat. Here again the moisture content is of prime importance, and the rise of temperature, conductivity of heat, and diffusivity of heat in different soils at different moisture contents have been carefully investigated during the year. Their relation to ordinary methods of cultivation has been studied, as well as their relation to special methods of cultivation, such, for instance, as flooding for cranberry culture. A publication has been prepared, giving the results of this work.

Among the fundamental investigations which the Bureau has continued during the present year has been the determination of the mineral composition of the different-sized particles or mechanical separates of soils, and it has been shown that those constituents which are of greater importance for plant sustenance, commonly known as plant-food elements, show a tendency toward segregation in the finer portions of a soil. A large number of typical soils of the United States have been analyzed in this connection and a discussion of their importance and significance has been prepared for publication.

In this connection the mineral composition of certain weeds that follow in annual succession certain of our common cereal crops has been studied, and it has been shown that these weeds in general draw as heavily upon the soil with regard to the ordinary mineral plant foods as do the preceding cultivated crops. It has been thus shown that the ability of a soil to furnish mineral nutrients is not always so important a factor in crop rotation as has sometimes been supposed.

A special investigation has been conducted upon soil carbonates, a subject which is of importance in understanding the formation of certain types of alkali in reclaiming affected lands in arid and semiarid regions, and also in determining the characteristics of soils in humid areas, especially where large quantities of iron are present. A bulletin covering these results has been published during the year. The relation of ferric oxid to certain mineral salts and acids has also been investigated, with especial reference to an extensive study of the differences, physical and chemical, between red and yellow soils—differences which have been definitely associated with crop-producing power and have long been the subject of discussion by geologists, as well as agronomists.

In cooperation with the Bureau of Plant Industry this Bureau has begun an investigation of the soils in areas where poisonous "loco" weeds exist, for the purpose of determining the origin and mode of segregation of the toxic constituent, barium, found in these weeds.

The solubility and chemical properties of certain soil minerals and fertilizers carrying phosphates and nitrogen have been investigated during the year for the purpose of furnishing precise data upon which intelligent advice could be given to properly authorized applicants, and an extended investigation of the chemical properties of humus has been continued, and important methods of studying this very important component of soils have been devised.

REPORT OF THE ENTOMOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., August 11, 1908.

SIR: I submit herewith an executive report covering the work of the Bureau of Entomology for the fiscal year ending June 30, 1908, dividing it, in accordance with your instructions, into the following headings:

(1) A summary of the important operations carried on during the fiscal year ending June 30, 1908.

(2) An outline of the plans proposed for work for the fiscal year ending June 30, 1909, under appropriations already made for that year.

(3) Suggestions as to work recommended for the fiscal year ending June 30, 1910, for use in preparing estimates for that year.

Respectfully,

L. O. HOWARD,
Entomologist and Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

WORK OF THE YEAR.

The work of the year beginning July 1, 1907, and ending June 30, 1908, may be classified, as it has been in previous years, as follows:

(1) Work on the Mexican cotton boll weevil.
(2) Work on the gipsy moth and the brown-tail moth.
(3) Importations of useful insects.
(4) Exportations of useful insects.
(5) Investigations of insects damaging forests.
(6) Investigations of insects damaging deciduous fruit trees.
(7) Cereal and forage-plant insect investigations.
(8) Work on insects injurious to vegetable crops.
(9) White-fly investigations.
(10) Investigations of insects in their direct relation to the health of man and domestic animals.
(11) Work on scale insects.
(12) Experimental work with insecticides.
(13) Work on insects injurious to stored products.
(14) Investigations of insects affecting tobacco.
(15) Inspection work.
(16) Work in bee culture.
(17) Work in silk culture.
(18) Miscellaneous work.

WORK ON THE MEXICAN COTTON BOLL WEEVIL.

The continued importance of the boll weevil as a factor in the reduction of the cotton crop was shown strikingly during the season of 1907. The Texas crop for that season was the smallest since 1896, and this is shown more clearly by the yield per acre than by the total crop. By the acre, the average yield was only 0.24 of a bale—the lowest on record for Texas. There were other factors than the boll weevil that produced this reduction of the 1907 crop, but the boll weevil was undoubtedly the most important one. A very conservative estimate of the damage from this cause would amount to $25,000,000. An important feature of the weevil situation during the year was the crossing of the Mississippi River in September, 1907, into the fertile cotton lands of Mississippi. Great damage will surely result in the moist valleys of this State and other eastern States of the cotton belt.

The appropriation for boll-weevil investigations was reduced to $40,000 for the fiscal year ending June 30, 1908. This caused extensive changes in the scope of the work, and only the more important lines could be continued. Others, which might eventually have yielded important results, but which had no immediate prospect, were discontinued. This seems to have been unfortunate from many points of view, and especially so as it was not possible to set aside a reserve fund for use in such emergencies as the possible discovery of isolated outbreaks in more eastern States.

EXPERIMENTAL FARMS.

As has been the case in previous years, much attention was devoted to experimental field work in different parts of the infested territory. Under contracts in formal agreements, work of this kind was conducted at six localities in Texas, two in Louisiana, and one each in Oklahoma and Arkansas. These experimental farms were chosen on account of peculiar local weevil conditions, since the problem of weevil control takes on different aspects from local conditions, to which the weevil reacts with great facility. Much information was obtained from this experimental work to complete our knowledge of the best methods of control under different conditions. Although in general the great importance of the general system of control perfected by this Bureau was again demonstrated, the importance of special expedients in particular cases was made very evident. These farms were watched carefully by competent expert assistants, and the records gave complete information that could not otherwise have been obtained. The farms were primarily experimental, but they took on to some extent the nature of popular demonstrations. In this way considerable local attention was attracted. The total area of these farms was 300 acres.

THE UTILIZATION OF COTTON STALKS.

As has been pointed out in the publications of the Bureau, the essential step in controlling the boll weevil is the destruction of the plants in the fall, but this has been taken up very slowly by planters on account of various difficulties. It was thought by the Bureau that if some use for cotton stalks could be discovered which would give a commercial value to the 13,000,000 tons, more or less, annually produced and now practically useless, a great advance would be made. Therefore the importance of the matter was presented to the Forest Service, and the paper laboratory of that service was furnished with a supply of cotton stalks for experimental purposes by the agent in charge of the boll-weevil investigations. According to the report of the Forest Service, the results in making paper from cotton stalks were better than expected, and a grade of paper was made which could be put to any use where color and strength of fiber would not be of great importance. This is the result of a preliminary test on a small scale, and it seems that much better results may be obtained by improvements on the rather rough method followed. It seems possible that cotton stalks may become an important source of paper-pulp supply, and should this prove true there may be a revolution with regard to stalks comparable to that which has taken place within the last twenty-five years with regard to cotton seed. This surely would go far toward eliminating the boll weevil as an important enemy of the crop.

GENERAL WORK ON THE CONTROL OF THE BOLL WEEVIL.

The work of the investigation, in charge of Mr. W. D. Hunter, was divided into 26 distinct projects, and among these the following indicated the most tangible results:

WORK ON THE UTILIZATION OF THE NATURAL ENEMIES OF THE BOLL WEEVIL.—It has been found that parasites are becoming much more effective naturally in controlling the weevil, and this promises favorable results from the efforts of the Bureau to encourage these insects. During the season the average parasitism was shown to have been doubled in Texas and trebled in Louisiana.

Work was carried on in introducing parasites from one region to another. At Shreveport, La., the planters took up the work enthusiastically, and great numbers of parasites were released there after shipment from various points in Texas, all of the species not having previously been found in Louisiana. A number of species brought from dry regions increased in number. Species from humid regions did not multiply so well on account of the very dry summer. Similar work was done at Dallas, Tex., and the effectiveness of several species was greatly increased by the introduction of material from other regions.

Important results were obtained through cutting down certain plants in the vicinity of cotton fields, thus forcing the parasites of the native weevils affecting these plants into the cotton fields to attack the boll weevil. This possibility was absolutely demonstrated, and marks a new procedure in the utilization of parasites. As pointed out in the last report, the fire ant, a native species known as *Solenopsis geminata*, was found to be increasing in efficacy as a weevil enemy. It was found that under some conditions the ant was destroying nearly 30 per cent of the immature weevils in the field. It seems to be acquiring a special taste for the boll weevil, and during the year it was found that this ant may be attracted to certain substances in which they will build their nests and accumulate in enormous numbers. In this way it will be possible to transport the ant and plant it in regions where it is absent or scarce.

MACHINERY FOR THE CONTROL OF THE WEEVIL.—A very striking proof of the value of a complete knowledge of the weevil and of the necessity for exhaustive work on its life history and habits has been the perfection of an implement which may very well be found in the course of time in use on every cotton plantation in the South. It has been found that the mortality of the weevil is much higher among the infested fallen squares which are in the middle of the space between the cotton rows where they are exposed to the more or less direct action of the sun, whereas when they remain beneath the plants and are shaded the mortality is much less. Therefore, what means can be adopted to bring the infested fallen squares to the open exposed middles? It was first proposed to plant the cotton on the high ridges and cultivate it by means of a disk implement in such a way as to maintain a measurable slope from the plants to the space between the rows, but there were many practical difficulties in the way of the adoption of this plan. Therefore it was desirable to invent a machine that would bring the squares to the space between the rows whether the cotton was planted flat or on ridges, and after many experiments Dr. W. E. Hinds, of the Bureau, perfected a machine that will accomplish the desired purpose. This machine has been patented in the name of the Department of Agriculture, and consists of a series of chains attached to a light frame in such a way that when it is dragged over the field the squares are removed from the shade and brought into a narrow pathway, where they are exposed to the direct rays of the sun. This machine has also been found to have a valuable cultural effect. It fills up the cracks in the soil and establishes a perfect dust mulch.

CHECK-PLANTING OF COTTON FOR THE CONTROL OF THE WEEVIL.—It has always been the custom in this country to plant the seed in drills, and this is the most convenient way, but another system, namely, the check-row system, such as is followed in planting corn in many regions, would undoubtedly increase the yield per acre and possibly reduce the cost of production on account of the elimination of much hand labor. It also appears that the check-row system would probably aid materially in the fight against the weevil. Plans were made in the spring of 1907 to give this system a thorough test in localities representing various conditions of soil, climate, labor, etc., and with different varieties of cotton. The carrying out of this plan was, however, rendered impracticable in several of the localities, owing to the great difficulty in securing good stands. However, careful studies were made upon a tract of 100 acres of check-cultivated cotton in comparison with an area of drilled cotton. Special consideration was given to the relative effectiveness of the more important factors of natural control, such as heat, ants, and parasites, operating during the summer months. The results, however, are by no means conclusive, owing to the abnormal character of the last season.

CONTROL OF THE WEEVIL DURING THE WINTER.—The study of the hibernation, which was in progress at the time of the publication of the last report, and which is mentioned in that report, has been completed, and a bulletin on the subject is about to be published. It is shown in what situations the most effective winter work may be done in controlling the insect, and also the relative effectiveness of the fall destruction of the plants at different times. It indicates that hibernation is different on different soils, and that consequently what would be necessary in one region might not act in another. The difference in soil temperature, due to texture and color, is apparently a factor which affects the survival of the weevil. It was found, among other things, that the Spanish moss growing on trees in all moist situations throughout the South, and which frequently lies on the ground beneath the trees in cotton fields, furnishes especially favorable facilities for the hibernation of the weevil. This would indicate more abundant hibernation in the Mississippi Valley and the eastern States of the belt, and complicates the weevil problem. Experimental work will be carried on in this direction, in the way of cutting down moss-covered trees, and so on. For this and other reasons hibernation in the Mississippi Valley is naturally more successful than in Texas. In Texas during March, 1908, for example, not more than 1,200 hibernated weevils per acre were found in the most heavily infested localities, but at the same time as many as 6,000 weevils per acre were found in the eastern portion of Louisiana.

INVESTIGATIONS AS TO SPECIAL MEANS OF CONTROL IN THE MISSISSIPPI VALLEY.—For the reason above mentioned, and others, special work on the life history of the weevil was begun in Alexandria, La. An agent was stationed there for some time during the summer season with an equipment for determining the special features of the life history of the insect in that region. One of the discoveries made was that the weevil may possibly find another food plant in the eastern part of the cotton belt. There is a species of Hibiscus growing throughout central Louisiana and extending over most of the eastern part of the cotton belt which is rather closely allied to the cotton plant. Cotton boll weevils were found feeding on this plant at Alexandria, and experiments were undertaken to ascertain whether they will breed in the fruit. Owing to the lateness of the season at the time the discovery was made, this fact has not yet been determined.

LARGE-SCALE DEMONSTRATION OF CONTROL BY FALL DESTRUCTION OF THE PLANTS.—The work on the experiment in Calhoun County, Tex., mentioned in the last annual report, in which the Bureau had the cotton plants growing on 410 acres of land destroyed early in October, 1907, continued to some extent into the present fiscal year. The favorable results indicated in the last report were more than verified. The crop grown on the experimental area was about three times as great as that upon the check located some miles away, where the plants had not been removed the preceding fall, and this in spite of a great difference in fertility and soil in favor of the check crop. The poorer experimental soil produced a crop which gave a net advantage to the farmers of about $20 per acre. The striking results of this demonstration were used in a circular regarding the fall destruction of the plants which was published in October, 1907.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

Efforts of the Bureau in controlling the gipsy moth have been confined to the plan of work outlined in last year's report, and after consultation with the most experienced men in New England in the work against this pest, it seems best to continue the same general plan in the future. This work consists practically in clearing up the thoroughfares leading from the most seriously infested localities, a strip a hundred feet wide on each side of the road being cut out by destroying the underbrush, removing poor trees, and burlapping the rest, all débris being also burned. In many places in Massachusetts at the present time the forests are seriously infested, and to keep trees along the roadsides through these forests so clean that caterpillars can not drop upon passing conveyances and thus become distributed over larger areas has been the constant aim of the work. In Connecticut, Maine, New Hampshire, and Rhode Island scouting has been continued in the slightly infested districts to prevent incipient colonies from becoming dangerous centers, trying for extermination where possible, and doing careful cleaning work wherever the moth occurs in large colonies in order to prevent any spread beyond the now known lines of distribution.

Work against the brown-tail moth has been carried on only along roadsides where the work was being done against the gipsy moth. In Maine, Massachusetts, and New Hampshire there are State laws requiring property owners and cities and towns to care for this pest, and in those States occasional advice to property owners with regard to removing the winter webs is practically the only effort made against this species under the Government appropriation. In Rhode Island, where the brown-tail moth occurs in small numbers in three or four towns, the scouts of the Bureau removed the few webs found and saw that they were destroyed.

WORK IN MASSACHUSETTS.

Underbrush and woodland along the principal routes of travel in infested districts have been cleared for the most part north and west of Boston excepting for about a mile in Quincy and 2 miles in Dedham. One hundred and thirty miles of roadside, 100 feet deep on each side of the road, have been treated, the new growth of brush coming up during the summer being removed each year. During the months of April to June, 1908, these roadsides were cared for by burlapping the trees and by applying tree tanglefoot where the insects were numerous enough to come from adjoining woodland. All of these roadsides have been sprayed with arsenate of lead, and perhaps 130 miles more of roadside have also been sprayed. The territory that has been covered is at present in such good condition as to cause frequent comment by persons driving or riding in trolley cars along the routes. During the summer of 1908 in many instances the trees back of the 100-foot strips have been stripped entirely of foliage, while in the 100-foot strips trees have remained in good condition and show hardly any signs of the feeding of the caterpillars. In many instances the work done by the Government has influenced property owners to perform similar work on their own property. In some cases this adjoins the work of the Bureau. In one instance a property owner agreed to clear acre for acre as much of his woodland as the Bureau would clear.

WORK IN NEW HAMPSHIRE.

Scouting operations were begun in New Hampshire November 6, 1907, in order to ascertain the exact occurrence of the gipsy moth in this State. This work was continued until the caterpillars began to hatch in the spring. In May the force was reduced to 10 men, who continued scouting the woodlands, the winter scouting operations having been confined to roadsides and orchards. The number of trained men has been increased. No serious infestation by the gipsy moth has been found in New Hampshire outside of the area known to be infested a year ago, but small colonies have been found in 15 towns not previously known to be infested. In this State the gipsy moth is now known to occur in 51 cities and towns, and on account of the lack of State funds the Bureau has burlapped and is attending to trees wherever the moth is known to occur. The extreme southeastern part of the State, from Portsmouth south and from Salem east, containing some 15 towns, is quite badly infested, the gipsy moth occurring on almost every estate and in many instances being abundant; but there has been little or no stripping of the trees this summer. The men engaged in scouting during the winter destroyed nearly 21,000 egg clusters, and thousands of orchard trees were pruned, scraped, and patched by cleaning gangs, who also destroyed a large number of egg clusters. The brown-tail moth has been plentiful enough in many towns to nearly ruin the apple crop this season.

WORK IN RHODE ISLAND.

In Rhode Island the State appropriation was nearly exhausted in December, 1907, and the State force was taken on the rolls of the Bureau and continued the cleaning work which had been begun. During the winter of 1906–7 80,000 egg clusters were destroyed in Rhode Island and during the winter of 1907–8 only about 7,500 were found, indicating a very great improvement in the condition. The State legislature made an appropriation of $10,000 in April, 1908, and the employees were retransferred to the State pay roll on May 1. The Bureau has assisted in summer work, however, and employed 50 men to turn burlaps and destroy larvæ. In addition, in the winter time scouting was carried on until the leaves made their appearance, and the gipsy moth was found in three towns not previously known to be infested, namely, a single egg cluster in Smithfield, one in Lincoln, and three in Cumberland. No caterpillars have been found at these places during the summer.

WORK IN CONNECTICUT.

In Connecticut the State has taken the entire care of the single colony at Stonington, the infested area being about 1 square mile. There has been a decided decrease in the insect, and continued persistent efforts will doubtless accomplish extermination. One of the best scouts of the Bureau was sent to Connecticut in April and remained there a month, discovering a few egg clusters within the bounds of the known infested territory, which had been overlooked by the State forces.

WORK IN MAINE.

The work of the Bureau during the past year in the State of Maine has been largely scouting work. During the winter forces of scouts examined practically all of the trees, except the woodland between Portland and Kittery and westward to the New Hampshire line as far north as the town of Acton, including 16 cities and towns. This resulted in locating the gipsy moth in small numbers in 5 towns not previously known to be infested. The moth does not appear to have spread any farther east than the line drawn a year ago, but in the southern part of the old territory it was found in considerable numbers. The Maine authorities, working under a special appropriation, have gone into the work in the heartiest spirit of cooperation, and with the work that they are doing with the assistance of the Bureau the gipsy moth is being effectively suppressed. Extermination is expected as the result of this year's work in a number of the outside towns, especially at an isolated colony on the property of the Soldiers' Home, at Togus near Augusta.

On the whole the work has been performed in the most admirable manner, and the condition of affairs is as satisfactory as could have been expected from the expenditure of the appropriations made. Serious damage has been done in woodlands about Boston during the early summer of 1908, and the foliage was completely removed in stretches of forest comprising many hundreds of acres. In such localities the pest can not be handled by the mechanical means in use, except by the expenditure of vastly greater sums than have been appropriated by the States and by the General Government, but, as indicated in previous reports, the prospect of the complete establishment of the principal introduced parasites probably will reduce this damage in the course of time to a comparatively negligible amount.

IMPORTATIONS OF USEFUL INSECTS.

The main work in importing useful insects has been the continuation of the very large-scale efforts to introduce and acclimatize the foreign parasites of the gipsy moth and the brown-tail moth. At the time of writing of the last annual report the active work of the season in this direction was practically completed. In the autumn the parasite laboratory was moved from Saugus, Mass., to Melrose Highlands, Mass. The new location is much more accessible to Boston and to most of the field colonies of the parasites. The buildings, including several substantial structures built for laboratory purposes by the State of Massachusetts, are much better fitted for the work. Upon the whole the results of the year's importations have been very promising.

In planning the work several new features have been introduced. The parasites that are constantly being sent over by agents belong to three main groups, namely those of the order Hymenoptera, including the Ichneumon flies, the Chalcis flies, and others; those of the order Diptera, including the Tachina flies, and those of the order Coleoptera, including the predaceous ground beetles. The amount of material received has been so great, and the character of the different life histories of the insects involved has been so diverse, that it has seemed of great importance to have a thoroughly trained expert, skilled in the biology of each group, placed in charge of each group. This has been done, and one expert has had charge of the Hymenoptera, another of the Diptera, and another of the Coleoptera. Further, the condition of European sendings by mail and by express during the summer of 1907 was by no means uniformly good. The sendings from eastern Europe, which are subject to long railway journeys in addition to the sea voyage, frequently arrived in bad condition. Therefore an innovation was made and a general laboratory depot was established at Rennes, France, under the general supervision of Mr. René Oberthür, and a skilled assistant, Mr. A. Vuillet, was placed in specific charge. Nearly all of the European sendings were shipped to Rennes, were examined, repacked, carried personally by Mr. Vuillet to Cherbourg or to Havre on the known days of sailing of certain steamers, then placed in the hands of chief stewards of the vessels and carried in the cold room to New York, where they were admitted without examination, and sent direct to Boston. This method has resulted in a much better average condition of the material received, and has facilitated the rapidity with which the work is being accomplished. The courtesy of the steamship officials is highly appreciated.

The third innovation has been an attempt to secure Japanese parasites of the gipsy moth. It has been known for some years that the true gipsy moth, or one of its varieties, or at least a most closely related species, occurs in Japan, though not in great numbers, and that it is apparently held in check by its parasites. Rev. H. Loomis, an American living in Yokohama, has repeatedly written to the State authorities of Massachusetts and to the Chief of the Bureau of Entomology conveying this information, and attempts have been made by mail and otherwise to send these parasites to the United States, but without success. Later information received from one of the most skilled economic entomologists of Japan, Mr. Nawa, indicated that there exists in Japan an important egg parasite of the gipsy moth. Remembering that the Massachusetts gipsy moth came originally from Europe, it seemed altogether desirable to introduce first the European parasites, and it seemed probable that these would by themselves reestablish the balance of nature. Then, too, the importation of the Japanese species seemed somewhat dangerous, on account of the chance that the Japanese gipsy moth might prove even more voracious and destructive than the European moth; but, after consideration, it was thought best to leave no stone unturned and to neglect no chances in the search for effective parasites. The European service of collectors and agents and advisers had been well organized and instructed during three annual visits of the Chief of the Bureau to Europe, and it was therefore decided to interrupt the European trip for the present year and to send an agent to Japan. Prof. Trevor Kincaid, of the University of Washington, at Seattle, was chosen on account of his skill as a collector, his comparative proximity to Japan, and the fact that he is personally acquainted with many persons in Japan. He sailed on March 2, and the results of the expedition have more than justified the expense involved. A very large amount of parasitic material has been received from him in good condition at Boston, and very many parasites from Japan have been colonized in the woodlands of New England.

Still another decided innovation has been the carrying on of active winter work with parasites, especially those secured from imported nests of the brown-tail moth, which began to come in from Europe in December. It was found quite possible to breed these parasites in artificially heated rooms, feeding them upon hibernating native brown-tail moth larvæ brought in in their nests from out of doors, feeding the latter upon lettuce and other hothouse foliage, and in the early spring securing more normal food for them by sending it up in boxes by mail from Washington and points south. In this way the breeding of the parasites of the genus Pteromalus was carried forward uninterruptedly throughout the winter, and, as during the breeding of successive generations they multiplied exceedingly, it was possible later in the year to liberate a vastly greater number of individuals than would have been possible had the imported species been allowed to hibernate normally in the nests. In the course of this work Mr. W. F. Fiske, in charge of the breeding operations, has invented a rearing tray which has been of the utmost advantage and which will greatly facilitate parasite rearing work in the future.

Still a fifth innovation, and one of great value, has been the discovery and practice of retarding the development of brown-tail moth eggs by keeping them in cold storage until the arrival of the European egg parasites, which will oviposit upon and breed in these cold-storage eggs as freely as in those which they attack in the state of nature. This process, it has been ascertained, may be carried on for a long time, and successive generations of these egg parasites may be reared from eggs retarded in their development by cold storage. It is thus easy to breed and to liberate an almost infinitely greater number of these egg parasites, and under favorable conditions, than would be possible from a simple importation of European parasitized eggs which would have to arrive in America at a specific time. These latter innovations have been due to the ingenuity of Mr. Fiske.

In the same way great advance has been made in the rearing of the Tachinid parasites, under the charge of Mr. C. H. T. Townsend, who has devised methods and made observations that have greatly added to our knowledge of the biology of these insects and have resulted in the accumulation of a store of information of the greatest practical value not only in the prosecution of the present undertaking, but in any problem of parasite introduction or control that may arise later. Extraordinary and almost revolutionary discoveries have been made in the life histories of certain of these flies, and without this knowledge the greatest success in handling them practically could not have been reached.

Similarly Mr. A. F. Burgess, in charge of the Coleoptera, has succeeded in a very perfect way in rearing and liberating the important European predatory beetle *Calosoma sycophanta*, as well as some other insects of the same family.

Altogether during the fiscal year the following material has been imported:

Brown-tail egg masses, about 26,000.
Hibernating nests of the brown-tail, from 50,000 to 60,000.
Larvæ and pupæ of the brown-tail, about 178,000.
Gipsy moth egg-masses, 7 boxes, each containing very many masses.
Gipsy moth larvæ and pupæ, about 161,000.
Gipsy moth larvæ from Japan, 8 large boxes, containing several thousand larvæ and parasite cocoons.
Predatory beetles, 2,892.

It will be noticed that only about half as many of the hibernating nests of the brown-tail were imported during this fiscal year as during last, but the smaller number is offset by the larger numbers of larvæ, pupæ, and egg-masses, so that the gross amount received is about the same as that of the previous year. The material received from Japan listed above came in before July 1, but in all there have been received about 40 boxes, nearly all of large size. From one shipment of the cocoons between 40,000 and 50,000 adults of one of the most important parasites of the genus Glyptapanteles were reared and were liberated directly in the open.

The colonization work has been going on rapidly during the summer of 1908, and of the species colonized the following have been the most numerous:

Pteromalus from the brown-tail moth nests	114,000
Trichogramma from the brown-tail eggs	11,600
Telenomus from brown-tail eggs	4,560
Apanteles of the brown-tail	12,875
Japanese Glyptapanteles	45,000
Meteorus from brown-tail	1,080
Pimpla from brown-tail pupæ	2,051
Unclassified Tachinids	4,177
Named Tachinids	1,600
Calosoma sycophanta, adults and larvæ	978

Thus making nearly 200,000 of the most active enemies of the gipsy moth and brown-tail moth liberated under the most favorable conditions during the year.

The results of the colonization work of previous years have not become very evident. It is altogether likely that the species introduced have found conditions favorable to their increase and that at the present time they exist in considerable numbers. The area, however, is so extensive as to make their occurrence in ordinary collections a matter of chance rather than of likelihood. There has been during the past two years a tremendous destruction of the larvæ of both brown-tail moth and gipsy moth from bacterial and fungous diseases. These diseases have appeared in spots, but unfortunately some of these localities were those where colonies of parasites had been established, and in the wholesale destruction of the caterpillars by disease the introduced parasites must have suffered severely. Knowledge has been gained, however, which will make it more easy to select better localities for colonization in the future. Several of the parasites have been found to have established themselves, and notably the predatory beetle *Calosoma sycophanta* has been found in numbers. At least seven species have been found under conditions which indicate their establishment.

There have been imported, in all, 23 species of Hymenopterous parasites, of which 16 are European, 6 are from Japan, and 1 at least is common to both regions. Eleven of these have been reared from the gipsy moth, 6 from the brown-tail moth, and 6 from both insects.

A number of species of secondary parasites have been reared and have been killed.

Of Dipterous parasites, at least 29 distinct species have been imported, of which nearly all are parasitic upon both gipsy moth and brown-tail moth.

Of Coleoptera, 5 species have been imported, all of which will feed upon both gipsy moth and brown-tail moth.

This makes a total of 57 beneficial species, enemies of gipsy moth or brown-tail moth, or both, that have been brought over in the course of this work.

The outlook is more favorable than at any period during the progress of the work. Success seems an ultimate certainty, but the time at which perfectly obvious results will be apparent is as yet uncertain.

OTHER IMPORTATIONS.

In the last report the announcement was made of an effort to introduce an egg parasite of the imported elm leaf-beetle. Sendings were made by two French correspondents, Dr. Paul Marchal, of Paris, and Mr. Ch. Debreuil, of Melun, last year, but, as stated in the report, the start was made too late in the year, the parasites issuing on the journey and dying before they could be liberated. During the present season, however, a sending was started late in May by Prof. Valery Mayet, of the École Nationale d'Agriculture, at Montpellier, arriving in Washington on June 1. The parasites, being in the act of emerging on receipt, were sent at once to the parasite laboratory at Melrose Highlands, were given a supply of freshly laid eggs of the elm leaf-beetle, and two generations have been reared. Colonies have been established in Harvard yard, Cambridge; in the vicinity of Melrose Highlands, Mass.; at Ithaca, N. Y.; at New Brunswick, N. J., and at Washington, D. C., and there is every reason to hope that an effective enemy of this destructive pest to shade trees will become established at a near date.

The South African parasite of the black scale, mentioned in previous reports, has done remarkably good work during the year in southern California. It has been particularly effective in the coast region.

EXPORTATIONS OF USEFUL INSECTS.

As has occurred in past years, the Bureau has endeavored where possible to return the many favors that foreign entomologists have done to this country, by sending them beneficial insects which may possibly be of service in foreign countries. It is comparatively seldom that this can be done, since, for example, while forty or more very injurious species of insects have been introduced into this country from the Old World, only three or four have been introduced from America into Europe, and it is seldom that the native parasites of a crop pest in a new habitat are sufficiently effective to warrant introduction into the original home of the pest. Nevertheless, as during previous years, various exportations of certain important parasites of *Diaspis pentagona*, a scale insect attacking the mulberry in southern Europe, have been sent to Italy, and certain beneficial Coccinellids have been sent to the British West Indies.

The experiment indicated in the last report, of sending the American sand-digging wasp *Monedula carolina* to Algeria to kill the Tabanid flies, which transfer a trypanosome disease of the dromedary, was carried through. The wasps, in the larval or pupal condition contained in cocoons, were received at Havre by representatives of the Pasteur Institute of Paris, carried to Algeria, and planted under favorable conditions. They were alive on receipt, and examination in the spring of 1908 showed them to be still living. It is too early as yet to judge of the success of the experiment from the standpoint of the results hoped for.

Owing to the fact that red clover is not fertilized in the Philippine Islands, it was considered desirable by the Bureau of Science at Manila to import American bumblebees in order that clover seed may be grown in the islands. In October, 1907, one of the agents of the Bureau collected a large number of bumblebees about Richmond, Ind., and these were placed in the hands of two Filipino students returning home from the United States. Certain of the bees were received alive at Manila, but no report has been made as to their establishment. The experiment will probably be repeated the present year with material from the Pacific coast.

INVESTIGATIONS OF INSECTS DAMAGING FORESTS.

The work in investigating forest insects, under the supervision of Dr. A. D. Hopkins, during the past year has been directed toward the completion of general information or additional facts regarding the principal insect enemies of forests and forest products, the character and extent of their depredations and practical methods of control, and also such special problems as were found to demand attention, as well as to the collection of data for publication. Extensive field investigations have been carried on in the national forests of northern and central Utah, northeastern Oregon, southern Arizona, southern New Mexico, and throughout Colorado, to determine additional facts concerning the distribution of the principal insect enemies of the Rocky Mountain forests. Field investigations have also been conducted in the forests of private owners, and on subjects relating to the interests of manufacturers, dealers, and consumers in eastern and northern California, Colorado, Michigan, West Virginia, Pennsylvania, Maryland, New York, and northern New England, to determine additional facts on which to base practical advice to private interests in forests, farmers' wood lots, and manufactured, stored, and utilized forest products. Especial efforts have also been made to get into close touch with the owners and managers of the more extensive private forest interests, in order to demonstrate to them the practical value of the results of the investigations of the Bureau and to secure their cooperation in the inauguration of insect-control policies. Much attention has also been given to working up the accumulated data for permanent record and publication, as well as to the fundamentally important systematic study of the species of injurious and beneficial insects involved in the more important problems. More time than usual has been devoted to cooperation with the Forest Service in the inauguration and application of insect-control policies in the national forests. The records and correspondence of the last year indicate clearly that there has been a quite general application of the advice of the Bureau to private interests in regard to methods of preventing losses from damage by powder-post beetles to seasoned hardwood products; damage to locust plantations by the locust borer; damage to white-pine plantations by the white-pine weevil; damage to forest products in general by wood-boring insects; damage to private forests by barkbeetles, and damage to storm-felled timber by wood-boring insects.

It was determined by a thorough inspection during the past year that the efforts of private owners and forest officials during 1905 and 1906 to control the alarming outbreaks of the Black Hills beetle in

1904 and 1905 in the vicinity of Palmer Lake and Colorado Springs and the adjoining Pikes Peak National Forest was a complete success. It was also demonstrated that the efforts of the owners of an extensive private estate in the vicinity of Fort Garland, Colo., to control the depredations of the same insect were equally successful. The first was accomplished by cutting and barking about a thousand trees, the products of which paid a large share of the cost and resulted in the protection of timber valued at more than a million dollars. The other was accomplished by the cutting and barking of less than 500 trees, resulting in the protection of timber of perhaps greater value than in the first example. The real value, however, of these two examples of successful control is far greater than that represented by the timber protected, since they serve to demonstrate, first, that the most destructive and dangerous enemy of the pine forests of the central Rocky Mountain region can be controlled at comparatively slight cost, or even at no expense, whenever the timber can be utilized, and, second, the absolute necessity of expert advice as a guide toward doing the right thing at the right time and at the least expense.

The necessity for the adoption of policies recommended by the Bureau has been markedly illustrated by the principal insect depredations to forests during the past year. For example, there has been continued destructive work of the Black Hills beetle in Colorado, Utah, and southern Wyoming. This species has caused an enormous loss of the best matured timber of the region, amounting to from 10 to 90 per cent over large areas in various national and private forests during past years. The mountain pine beetle has been continuing its ravages in the open forests of the northern Rocky Mountain and Pacific coast States, especially in Oregon and California. This beetle has killed from 75 to 90 per cent of the lodgepole pine over an area of 100,000 acres or more on Big Sheep Creek and Imnaha River in northeastern Oregon, and its ravages are being continued to such an extent that it is threatening the destruction not only of the remaining lodgepole pine but of the more valuable yellow pine of the Imnaha National Forest. The southern pine beetle, which caused widespread devastations in West Virginia in 1891 and 1893, is again making its appearance in destructive numbers in southeastern Virginia; the larch sawfly has been exceedingly destructive to the larches of northern Michigan, and reports from a large number of the principal owners of pine timber in the areas in Mississippi, Louisiana, and Arkansas devastated by the tornadoes of September, 1906, and April, 1908, indicate that losses amounting to from 10 to 50 per cent or more, or over a billion feet of storm-felled timber, were caused by wood-boring insects, principally the so-called "sawyer." The damage to forest products by wood-boring insects, especially that to seasoned hardwood products, continues to cause serious loss. However, much more of the loss is now being prevented than in past years, through the utilization of advice given out by the Bureau. The twig-blight affection of the white pine of northern New England, which appears to be caused by a species of Chermes, has attracted more attention and caused more alarm during the year than any other trouble affecting forest trees, and, while the actual damage has been comparatively slight, it has been the direct cause of great loss on account of the alarming appearance of the trees and the consequent reduced values of timber and real estate, much of which has been sold at a sacrifice. This trouble has been investigated both by the Bureau of Plant Industry and by the Bureau of Entomology, and much important information concerning the life history of the Chermes and of its migrations from pine to spruce has been gained.

The work in the control of forest insects, therefore, is in a most satisfactory condition, and the practical results achieved in the way of saving losses emphasize the value and importance of the work and lend every hope to the future.

INVESTIGATIONS OF INSECTS DAMAGING DECIDUOUS FRUIT TREES.

The work of the Bureau in investigating the insects injurious to deciduous fruit trees, in charge of Mr. A. L. Quaintance, has been in the main a continuation of the projects already in progress at the close of the last fiscal year, and some additional lines of investigation have been undertaken.

PEACH BORER AND PLUM CURCULIO.

Comprehensive work covering a large geographical field has been under way with the peach borer and plum curculio for the past three years. Variations in life history due to location, and which are of much importance in the application of remedies, have been studied with excellent results.

The tests of washes, repellents, etc., on trees to prevent infestation by the peach borer have been continued and extended, and the results obtained by the close of the growing season of 1908 should permit the drawing of final conclusions not only as to the efficiency of the treatments in preventing infestation, but also as to the effect of these treatments upon the trees.

With the plum curculio the work during the fiscal year was confined largely to life history studies in regions not previously covered, as in the Ozarks in Arkansas, and in the State of Michigan, and also to the further testing of various brands of arsenate of lead as to the possibility of their use on peach and other stone fruits. All of the available arsenicals have now been carefully tried throughout several seasons and at different strengths in different numbers of applications in southern, middle, and northern latitudes. It has been determined for the Middle and Southern States that the use of arsenicals in any form is likely to be followed by serious injury to the foliage and fruit, the injury varying in extent and becoming greater in wet weather. In the more northern States damage of this kind is of much less importance, although the use of arsenicals even for this territory can not be unqualifiedly recommended. Studies have been made, in cooperation with the Bureau of Chemistry, to determine the exact source of injury to peach and other stone fruits by arsenate of lead. Since this is an insecticide supposed to contain practically no free arsenic, the cause of this injury has been obscure.

CODLING MOTH.

The investigations of the codling moth, begun in 1906, have been continued. As with the insects just mentioned, detailed life history studies in typical fruit-growing regions in different parts of the country have been made in order finally to furnish data for a complete account of this apple pest for the United States as a whole, this necessarily indicating differences in treatment based upon differences in the behavior of the species in different localities. During the past year studies have been made at Siloam Springs, Ark., at Washington, D. C., and in the near-by orchards of Virginia and Maryland, at North East, Pa., and at Douglas, Mich. Recent investigations in Utah and the State of Washington have indicated for that region the practicability of controlling the codling moth during the entire season by spraying for the first generation only. The importance of this subject to apple growers as reducing the number of applications necessary to control the insect rendered careful experiments necessary to determine the effectiveness of the new method of applying sprays as compared with the usual method in practice, and especially the effect of excessive treatments when used with Bordeaux mixture in combination spray against the codling moth and the apple scab.

Demonstration spraying for the control of the codling moth, done in some instances in cooperation with the Bureau of Plant Industry, has been completed for Virginia, southern Ohio, and Pennsylvania. In Virginia the experimental work resulted in the harvesting of 94.71 per cent of perfect fruit from the sprayed trees, as against 22.51 per cent from the unsprayed trees, with the yellow and Newton pippin apples. The net gain per tree from the spraying operations in this case was $11.88. Equally favorable results were obtained in Pennsylvania. The comparative merits of dusting and spraying in the control of the codling moth and of apple diseases was taken into consideration in the work arranged for the spring of 1908 in the Middle West. This work was begun under favorable conditions, but was subsequently considerably interfered with on account of the reduction of the fruit crop by cold in the orchard where the work was located.

An effort has been made to introduce the European parasites of the codling moth, and during the fall of 1907 and the winter of 1908 shipments of codling moth larvæ were received from several localities in Germany, and three different species of parasites were reared. Systematic efforts have been made to acclimatize these species, but the present conditions are unfavorable. The effort will be continued another winter.

SAN JOSE SCALE.

Work done with the San Jose scale has consisted largely in the testing of self-boiled lime-sulphur wash as a summer treatment for infested trees, and experiments in the fumigation of infested fruit designed for the export trade. Conclusions as to the value of the first line of work can not be reached until the close of the season of 1908.

Very careful work was done in regard to the fumigation of scale-infested fruit for export. While danger of the introduction of the scale in this way into foreign countries is very remote, foreign governments still exclude scale-infested fruit. Experiments were conducted in cooperation with the Bureau of Plant Industry, and were done in a most thorough way. Some 90 different experiments were made, requiring the careful examination of thousands of scales, and it was shown to be perfectly feasible, under proper conditions, which will be described in special publications, to kill all scales on fruit in commercial boxes, both wrapped and unwrapped, in original barrels, with a certain number of auger holes in each end, in original barrels with the top removed, in original barrels with the bottom removed (this being replaced by a special retaining screen header), and also with apples in bulk; but the process was not perfectly effective in unopened barrels.

PEAR THRIPS.

As ordered by Congress, an investigation of the pear thrips was begun at the beginning of the fiscal year, and a field laboratory near San Jose, Cal., was located for this purpose. Two men familiar with California conditions were assigned to the work, which has been vigorously prosecuted. The life history studies of this insect, reported upon in Bulletin 68, Part I, of this Bureau, have been enlarged and important points confirmed. Especial attention has been given to experiments in the field with methods of control. Various sprays have been used on a sufficiently large scale to admit of their practical value in orchard use. Two sprays give promise of efficacy, namely, tobacco extract and the distillate emulsion. Careful tests have been made of flooding the ground with water during the summer, as practiced in irrigation. Further tests of this general character are under way.

CRANBERRY INSECTS.

Beginning with the spring of 1908, an investigation of cranberry insects in the Wisconsin bogs was undertaken in cooperation with the agricultural experiment station of the University of Wisconsin. The subject of cranberry insects in the bogs of New Jersey has already been treated in the publications of the Bureau, but investigations indicate that there are important points of difference in the habits of some of the well-known cranberry insects in Wisconsin, and methods of control must therefore be different. An agent of the Bureau has been stationed at Cranmoor, Wis., to carry on this work, where the cranberry experimental farm of the University of Wisconsin is available for use.

GRAPE ROOT-WORM.

In accordance with the provision of Congress, an investigation of the grape root-worm in the Erie grape belt was undertaken beginning with the spring of 1907. This work was carried on through that year, and continued and enlarged beginning with the spring of 1908, at which time cooperative arrangements were made with the Pennsylvania State Department of Agriculture. A close study of vineyard conditions has been made to determine the amount of injury for which this insect is responsible and the amount of injury done to vines of various ages. Large-scale spraying experiments have been carried on in the vineyards but recently infested, with a view to the furnishing of protection from the insect and maintaining the present standard of grape production. Large-scale experiments have also been carried on to determine the possibility of bringing badly injured vineyards up to a state of profitable production and to ascertain the best means of furnishing protection to young vineyards just coming into bearing. Very decided results as to the value of cultivation and of timely spraying with arsenicals have been obtained. A basis for judging the abundance of beetles in vineyards is to be found in the abundance of eggs deposited upon the grape leaves, and examinations of grape canes for eggs in sprayed and unsprayed areas show for unsprayed vineyards an average of 352 eggs per vine as against 38 per vine for sprayed plats. Vineyardists in the region indicated have been greatly alive to the value of the work, and the recommendations of the Bureau have been adopted to an unusual degree.

MISCELLANEOUS INSECTS.

A serious outbreak of two species of barkbeetles in peach orchards in Ohio has developed, where the orchards, owing to local conditions, have in recent years been more or less neglected. A field laboratory for the investigation of this work has been established at Lakeside, Ohio, at the request of the Ohio Agricultural Experiment Station.

The grape-vine Phylloxera has been under investigation during the fiscal year 1908 in California, especially with reference to its life history, which in California appears to differ from the standard life history worked out by Professor Riley years ago in Missouri and as determined by numerous investigators in Europe. In cooperation with the Bureau of Plant Industry, a study is being made of the comparative root resistance of various varieties of grape to the grapevine Phylloxera, as bearing upon their usefulness for grafting stock.

An interesting and important investigation has been carried on relative to the effect of sulphuring on the insects affecting drying and dried fruits in California.

The grape berry moth has been studied in Pennsylvania and Ohio, and it has been demonstrated that by thorough and timely use of arsenical sprays even the worst infested vineyards may be greatly improved during the course of a single season.

Numerous other insects are being investigated incidentally at the different field stations and at the insectary in Washington, D. C., as opportunity offers, and a large amount of data is being accumulated which, while yet incomplete, will prove useful when more attention may be given to the respective species.

CEREAL AND FORAGE-PLANT INSECT INVESTIGATIONS.

All the investigations of cereal and forage-plant insects, in charge of Mr. F. M. Webster, in hand at the end of the fiscal year 1906–7, were continued through the following fiscal year with gratifying success. There was a destructive outbreak of the wheat-straw worm (*Isosoma grande*) in the State of Washington, which gave increased importance to the joint-worm investigations that have been conducted during previous years. There was also a serious occurrence of the Hessian fly in Kansas and northern Oklahoma, while the damage done by the spring grain aphis or so-called "green-bug" during the spring of 1907 rendered increased efforts toward a better and more practical knowledge of this pest absolutely imperative.

THE SO-CALLED "GREEN-BUG" AND ITS PARASITES.

Owing to several disastrous outbreaks of the spring grain-aphis or so-called "green bug" during the last seventeen years, it has become one of the most dreaded of all of the grain-affecting insects of the southern part of the grain-growing regions of the country. The outbreak of 1907 extended farther north than any of which we have any record, and grain growers all over the country were much exercised. In the spring of 1908, even as far north as Ohio, Indiana, Illinois, Wisconsin, and Minnesota, grain growers were uneasy and apprehensive of renewed trouble from attacks of the pest, and the Bureau was frequently applied to for advice as to the probability of a recurrence and the advisability of sowing spring grain. There was during the greater part of the fiscal year very little money that could be expended for investigations of this insect. Late in the session Congress appropriated $10,000 for this purpose, making the amount immediately available on the passage of the agricultural bill. It was practically June 1, 1908, before the fund became actually available, so that almost no results from its expenditure can appear in the report of the operations of the fiscal year ending June 30, 1908. The studies of the previous fiscal year, however, were continued practically through the following year, and the investigations of one of the experts of the Bureau carried the life cycle of the insect practically from June, 1907, until June, 1908. There is then a complete life history of the insect in the northern part of the country, which, however, may or may not prove similar to the development history in the South. In the late summer of 1907 another agent traced the pest in the fields in considerable though not destructive numbers in Nebraska, Iowa, Minnesota, and North Dakota quite to the Canadian boundary, and during June of the present year the same agent found it in the vicinity of Brownsville, Tex. In the summer of 1907 the insect was also found in northern Maryland, Washington, D. C., and farther south.

Investigations begun early in the spring of 1908 indicated no such prospect of such an outbreak as occurred in 1907. The whole range of the species, however, was covered, and the situation at the end of June seemed to be that over its entire range the species was present in limited numbers and awaiting only favorable meteorological conditions to again become destructive. There was, therefore, before the close of the fiscal year no opportunity for large-scale remedial work such as was doubtless anticipated by the Congressional appropriation. The appropriation, however, will admit of a careful study of the insect over the greater part of its range, and may result in the finding of facts which will prove of practical value another season.

WORK ON JOINT-WORMS.

The joint-worm investigations have been continued, and have resulted in the accumulation of much material and many interesting and important notes. The serious outbreak of the wheat-straw worm (one of the joint-worms) in the State of Washington showed conclusively that it is capable of doing very great damage on the Pacific coast. Experiments with remedies were carried on during the early summer of 1908, and some experiments have been made in the way of transporting parasites from the East and Southwest to determine whether they can be colonized on the Pacific coast to the advantage of wheat growers. An important but rather disappointing fact was ascertained to the effect that in the State of Washington, as in the more southern portions of the Central and Eastern States, the females of the spring brood of this insect are more generally winged than farther east and north; therefore, crop rotation is less effective against them, and the necessity for the discovery of new measures on the Pacific coast is indicated. It is hoped that the introduction of eastern parasites may be of great service in the State of Washington.

HESSIAN FLY INVESTIGATIONS.

The wheat-sowing experiments mentioned in previous reports were continued in the East, and in the fall of 1907 a series of three was begun in Kansas. Two of these—one near Sedgwick and the other near Caldwell—were in the midst of a serious outbreak of the pest. The results of these sowings, checked by other fields, show that if the farmers in the latitude of Sedgwick, Kans., had sown no wheat until after September 20 there would have been no injury from the Hessian fly. At Caldwell, Kans., near the Oklahoma line, had no wheat been sown until October 10 there would have been no outbreak of the fly this year. Soft wheats sown at the same time as hard wheats in the same localities were more seriously affected. In other parts of the country these sowings are being continued, and valuable information is being gained.

Further experiments were made with regard to the colonization of parasites. In the last report it was shown that the transfer of parasites from Marion, Pa., to Sharpsburg, Md., resulted in a tremendous multiplication of the parasites at the latter locality and in the great reduction in numbers of the Hessian fly. Further investigations of the results of this colonization the present year have given conclusive proof of the success of the experiment. Not only did critical examination of all material secured in July, 1907, at Sharpsburg show that all of the Hessian fly flaxseeds contained the parasites of the genus Polygnotus, but additional material secured in the spring of 1908 in the same locality showed all of the Hessian flies to be parasitized. Additional efforts were made the present year to transport the same parasite from Marion and Chambersburg, Pa., to Kansas, in localities where the Hessian fly did not appear to be parasitized, but the success of the experiment and the estimation of its results were hampered by the subsequent appearance of another parasite of the same genus which had in 1905 been carried by agents of the Bureau from North Dakota into western Kentucky. A just estimate of the bearings of this experiment can not be had until the autumn of 1908 or the spring of 1909.

OTHER INVESTIGATIONS.

Additional studies have been made of *Clivina impressifrons*, a beetle which destroys seed corn after planting, and a large number of experiments have been made in treating the seed before planting. None of the treatments rendered the seed immune to attack, but certain of the mixtures seem to have produced some benefit.

A new enemy of clover has been discovered in Maryland; experiments have been made upon the corn root-aphis, and studies of the native grass food plants of the chinch bug and of certain insects affecting sorghum and timothy grass.

Investigations of the influence of various strains of honey bees in fertilizing the bloom of red clover were carried on. The first bloom was certainly fertilized by the bees, and the evidence is that the varieties with the longest tongues are the most effective. With the second bloom, however, the results were less convincing.

WORK ON INSECTS INJURIOUS TO VEGETABLE CROPS.

The scope of the work on insects injurious to vegetable crops, in charge of Dr. F. H. Chittenden, has been very considerably augmented during the past year by an increased allotment of funds, which has permitted the employment of additional agents. The work on insects injurious to truck crops in Texas has been continued by the urgent request of prominent growers in that State and by agents of the Bureau of Plant Industry in charge of experimental farms in Texas, a portion of the work being done in cooperation with the State experiment station. Similarly urgent requests have been made for the continuation of work begun in a preliminary way two years ago in Florida. Much has been accomplished in the latter State by keeping an agent there throughout two years. The same agent has been able to visit Georgia, where there is a demand for work on truck crop insects. By the request of the Virginia Truck Experiment Station and the Bureau of Plant Industry of this Department, as also the Southern Produce Company of Norfolk, Va., an agent has been stationed since April, 1908, in the trucking region of Norfolk, which has an annual output of $6,000,000 in truck crops. Good results have already been obtained and much is promised for the future in that vicinity in cooperation with the institutions mentioned. The investigations when completed will, it is hoped, comprise a very thorough study of all the truck-crop insect pests of that region.

Although the insects injurious in the different regions where this work is being done are some of them similar in character and in some cases identical with those inhabiting more northern regions and the West, the problems are quite distinct. The insects common to two or three regions have different life histories and different habits, and, owing to the difference in climate, they require different remedies or modifications of the same remedy. In the very moist climate of Florida, for example, these insects can not be handled in the same way that they are in the dry climate of southern Texas, the frequent rains in the former locality washing off the ordinary insecticides such as Paris green. Here the addition of some adhesive substance was found necessary. The southern Texas trucking region is rapidly increasing its area and sends the earliest supplies to more northern regions, including such large cities as Kansas City, Cincinnati, Louisville, and Chicago. Moreover, as this is a new trucking region in close proximity to Mexico, new insects are attacking truck crops, and there is every reason why the work in this region should be considered important. Florida—particularly southern Florida, where investigations have been conducted—furnishes the earliest vegetables to practically all of the large eastern cities, including Washington, Baltimore, Philadelphia, New York, and Boston. In the Norfolk region the plants grow considerably earlier than they do in the neighborhood of Washington, and they supply both an early and a late market to the cities of the North.

The work that has been carried on in Texas has been very successful, and has had the practical end mainly in view. Very many field experiments have been made, and the truckers of that region have been put in possession of information which will be of great service to them.

The insects which attack vegetable and truck crops are of so many distinct species that specific mention of any of them can hardly be made in a report of this character, although all will be considered in other publications.

In Florida the work has been of the same practical character, with especial attention given to experimental work with remedies in the field, and the results have been comparably successful.

One of the important investigations that have been carried on under this head during several years has been the study of insects affecting the sugar-beet industry in the West. During the past year this work has been done in cooperation with the State Agricultural Experiment Station of Utah. The destructive beet leaf-hopper, known in some localities as the " white fly " of the sugar beet or the " blight," has been thoroughly studied, and a report of the results is now in process of publication. All of the sugar-beet regions of Utah, and most of the important sugar-beet districts of the West, including portions of the States of California, Arizona, Oregon, and western Idaho, have been visited. Local outbreaks of leaf-eating caterpillars, an army worm, and a webworm in southern Idaho, were investigated, and methods of control were successfully tested. In certain sections of California it has been ascertained that by planting beets in November and December—that is to say, before the winter rains—a considerable degree of immunity is secured from ordinary spring injury by insects.

Aside from the work in Texas, Florida, and Virginia, and upon the insects injurious to the sugar beet in the West, very many truck-crop insects have been studied in other parts of the country, and very satisfactory progress has been made in the whole field.

WHITE-FLY INVESTIGATIONS.

The investigation of the citrus white fly has been continued on an enlarged scale under the increased appropriations granted by Congress for this work. Three men have been employed in the field throughout the year with headquarters and laboratory at Orlando, Fla. The white-fly situation and work in Florida, and also the white-fly outbreaks in California, were carefully inspected early last winter by Mr. C. L. Marlatt, Assistant Chief of Bureau, who has general direction of the white-fly investigation.

The study of the life history of this insect has now covered nearly all of the important features in as thorough a manner as is necessary for practical purposes. The accumulation of exact life-history data is essential for correctly outlining methods of control under different conditions. A bulletin is in preparation which will give the results of this feature of the investigation.

In the study of methods of control most attention has been given to those lines which the first year's work showed to be especially promising. These lines are: (1) Control by means of the fungus parasites of the insect, and (2) control by fumigation.

Concerning the first, it may be said that while the extensive experiments and observations of the year have greatly extended our knowledge concerning the fungus enemies concerned, they have failed to bring out or to sustain any method by which the different species of fungi can be relied upon to produce entirely satisfactory control. As has been stated in the preceding report, the effectiveness of these parasitic fungi is much greater in certain sections of the State than in others. The observations of the past two years indicate that in no section of the State of Florida is the effectiveness under normal conditions sufficient to make direct methods of control undesirable. Nevertheless the beneficial effects of these fungi, when they are favored by atmospheric conditions, make the problem of utilizing them to better advantage a very attractive one, and the investigation will be continued until the possibilities and limitations of these fungi are fully understood. The "brown white-fly fungus," a species whose spores are unknown and which consequently is at present undeterminable, is the most effective of the fungus parasites near the west coast of Florida. In Manatee County a hyperparasitic fungus has been found which decreases materially the efficiency of the brown fungus and complicates the problem of using this species of white-fly parasite to best advantage. The brown fungus is not of general occurrence in the central part of the peninsula, but even here it frequently becomes very useful. The yellow and the red fungi (Aschersonia) are common in nearly all sections of the State and in some places have done good work during the past year. The yellow Aschersonia, like the brown fungus, has been found to be subject to the attacks of a hyperparasitic form, which has reduced its efficiency. In the central and northern parts of the Florida peninsula the reduction of the white fly by the drought of the winter of 1906–7 resulted in checking the parasitic fungi which, under natural conditions, flourish only when the white fly is excessively abundant.

Experiments in fumigating for the white fly have been continued on a large scale, with favorable outlook for the complete success of this process. The data obtained in the experiments conducted in January and February, 1907, have been tabulated and a new form of dosage table and an improved tent have been devised, by means of which the estimation of the dosage requirements does not necessitate reliance upon experts. Any orange grower with this system, by following simple instructions, can fumigate his trees with the same degree of accuracy as could the most experienced expert. A fully illustrated bulletin has been published, giving detailed instructions for the fumigation of citrus trees in Florida. During the months of December, 1907, and January and February, 1908, the agents of the Bureau in Florida fumigated approximately 4,000 citrus trees of all sizes, testing on a large scale the dosage table which had been based on the experiments of the previous winter. Much was learned from these tests and the profitableness and practicability of the process in Florida was fully demonstrated. The provision by Congress for the investigation of the process of fumigation in California has left for the work in Florida only those points which are intimately concerned with the insect under investigation or are peculiarly connected with local conditions. The experimental work of next season will complete the investigations concerning fumigation for the white fly.

Attention has been given to reaching as large a number of citrus growers as possible with practical demonstrations. During the last year demonstrations and experiments in fumigation were conducted in St. John, Orange, Hillsboro, Manatee, and Lee counties, and a great deal of interest has been manifested by the citrus growers throughout the State.

Comparatively little attention has been given to the subject of spraying during the past year, as the results of the experiments in fumigation showed conclusively that this latter method was more economical and satisfactory under ordinary conditions. Spraying is practiced, however, with success by some orange growers, but in the main the results have been unsatisfactory and expensive. In hammock groves, where the citrus trees are grown among the native palmettos for protection from cold, and in groves grown in sheds, also for protection from cold, spraying will continue to be the most practicable method of control. Spraying will also be of considerable value in controlling new infestations until arrangements can be made for the more thorough measure of fumigation.

The investigations in regard to life history and direct methods of control are now in position to be concluded during the fiscal year ending June 30, 1909, allowing more time to study fungous and bacterial diseases and insect parasites.

No new outbreaks of the white fly have been reported from California, and the State authorities are proceeding with the work of extermination referred to in my last annual report.

That the white fly is a native of eastern Asia has long been believed, the evidence, however, being very meager. During the year we have received citrus and other material from Shanghai infested with the white fly, making it all the more desirable at some time in the future to have a competent exploration made of southeastern Asia to determine the native home of the white fly and to discover and import any natural enemies which may be found there.

INVESTIGATIONS OF INSECTS IN THEIR DIRECT RELATION TO THE HEALTH OF MAN AND DOMESTIC ANIMALS.

WORK ON THE HOUSE FLY.

Presumably owing largely to the very general spread of the information contained in Circular No. 71 of the Bureau, the country has been aroused during the past fiscal year as never before to the danger of permitting the house fly to breed unchecked and to carry filth and disease throughout communities. Many boards of health have taken up the matter, and much work has been done to emphasize the importance of this insect as a disease bearer. It is inconceivable that human beings should so long have viewed this insect as a simple nuisance, and the public indifference has been due not only to the general ignorance of the danger but to the lack of such knowledge and comparative apathy on the part of boards of health as well as the medical profession in general. The very name "house fly" suggests nothing harmful, and it is proposed that if in all publications in the future this insect be known as the typhoid fly or as the manure fly, even the average individual will without trouble absorb some idea of its objectionable qualities.

Although the full life history and most facts concerning the house fly have been displayed in previous years in publications of the

Bureau, beginning with the early summer of 1908 an effort was made to learn certain facts connected with the seasonal abundance of the insect, with the idea of comparing at the close of the season the curve of house fly increase and decrease with the curve of typhoid increase and decrease, in the hope of emphasizing in this way the part played by the house fly in the carriage of typhoid, which is becoming more and more accepted even under city-conditions. It seems certain that many otherwise inexplicable cases of typhoid, and even of epidemics of typhoid, are entirely or largely to be laid to the carriage of the causative organism by this fly.

WORK ON THE TEXAS CATTLE TICK.

Three investigators have been at work upon life-history studies of the cattle tick, and these studies have been continued in the directions indicated in the last report. The work has consisted of experiments and observations designed to reveal better methods of control or eradication than are known at present, as well as improvements upon the plans now in use. The extensive work in eradication that is being carried on successfully by the Bureau of Animal Industry makes it highly important to have the fullest possible information at hand. The most important means of control of the cattle tick depend upon the longevity of the seed ticks and the length of their development on the host. To determine the longevity of the seed ticks, experiments were conducted at Dallas and Victoria, Tex. The ticks were placed on the ground in cages, so that natural conditions existed. The results will show the exact length of time necessary to keep animals from any certain pasture to cause the death of the pests. This period varies in different seasons and in different regions. Therefore extensive work must be conducted at different places and continued throughout a series of years, the results gaining greatly in value as the work is continued.

The point in the life history of the fever tick which makes it most susceptible to treatment is that for many practical purposes it is entirely restricted to cattle. Nevertheless other animals, such as horses, sheep, and deer, as well as dogs, may act as occasional hosts. The extent of possible dissemination by means of hosts other than cattle is of great importance in control, and it has therefore been necessary in the course of this investigation to make extensive collections of ticks from various animals in the field to determine the occurrence of the fever tick as well as to test the question in the laboratory by confining numbers of seed ticks with various animals.

As a result of the study of the life history of the cattle tick it has been found possible to lay down an important law regarding the time in the winter when cattle may be allowed to run in pastures without becoming infested. This discovery is based upon the fact that the tick eggs do not hatch in the spring until a certain number of degrees of effective temperature has accumulated. One of the great difficulties in the control of the tick is that many ranchers are overstocked and can not keep part of their holdings of cattle from certain fields for the time requisite to starve out the ticks. This difficulty can be minimized as the result of the discovery above mentioned, since it will show the latest date upon which it will be safe for cattle to remain in the pastures from which the ticks are to be eradicated or reduced in numbers. It is considered that the discovery of this law, concerning which a preliminary notice was published during the year, will eventually be of great importance.

During the year internal parasites of two genera of ticks were found. This discovery is of much interest, since no such parasites of ticks had been previously known to exist. In one instance parasites occurred in considerable numbers in a species of tick closely allied to the cattle tick. These observations led to experiments attempting to cause these parasites to attack the fever tick. These experiments are still under way.

Incidentally studies have been made regarding other species of ticks. It is likely that some of the other forms will be found to transmit diseases of various animals. This has been shown recently by the demonstration of the agency of a tick in the transmission of so-called "Rocky Mountain spotted fever" of human beings in this country. Therefore collections have been made wherever possible and material has been bred in the laboratory to determine the main points in life history and development.

Practical demonstration was made, on a large ranch in southern Texas, of the application of a method of control resulting from life history investigations. A square mile was fenced off in one corner of a 30,000-acre pasture; the cattle were removed in July and returned in December after having been dipped thoroughly to remove the ticks that were upon them. The cattle in the large pasture served as a check upon the ones in the experimental square mile. The results in the control of the tick were so conspicuous that the owner of the ranch thought that the pest had been completely exterminated. As a matter of fact, however, on 65 head of cattle 7 ticks were found, but in the case of the outside cattle there was a heavy infestation. This successful demonstration of control, amounting almost to eradication, will have an important effect in popularizing methods of control, and will thus assist greatly in the plan of extermination that is now being followed by the Bureau of Animal Industry. It indicates further what may be done by an individual cattle owner on a large ranch far south of the quarantine line drawn by the Bureau of Animal Industry.

WORK ON SCALE INSECTS.

The scale-insect enemies of woody plants and shrubs are very readily carried with their host plants, and hence in the introductions of plants, as will be seen under the report on inspection, pests of this category figure very largely. During the year a considerable number of new and possibly dangerous scale pests have been intercepted and destroyed, particularly on material imported from northern China. It will be remembered that the San Jose scale came from northern China, and this insect was represented on much of the plant material received from that source. With it on different plants several other scale insects were found, similar in habit and giving evidence of equal capacity for harm. Descriptions of these new species have been published by the Bureau, in order to facilitate their ready identification and to be of service in quarantine inspections.

The Departmental collection of scale insects, indispensable for the identification of such pests, has become the best collection in the world, and the Bureau is especially well equipped for inspection work against insects of this class and for the identification of the insects themselves. The work of a good many years has resulted in the accumulation of the best type collection of scale insects in existence, and very recently has been received for study and comparison the very large and important collection made by the late Mr. W. M. Maskell, of New Zealand, hitherto practically inaccessible to students. The opportunity of studying this collection will be of great value to the work of the Bureau.

As in former years, a great deal of scale-insect material has been identified for experiment stations and State entomologists and others.

The important scale pests of deciduous, citrus, and other fruits have been under investigation, and the results will be referred to under the appropriate sections.

Life-history work on several species of Eulecanium and Pulvinaria has been carried on successfully, resulting in the reduction of several supposed American species to synonymy with European species. *Pulvinaria innumerabilis* (Rathv.) has been determined to be absolutely identical with *P. vitis* (L.) of Europe, as have also several other supposedly valid American species, an account of which will appear later. *Eulecanium armeniacum* (Craw), which is a common pest on peach and prune in California, and on plums in New York State and other parts of the East, is identical with the European *E. persicæ* (Fab.), as are several other supposedly valid American species.

A new species of Physokermes has been found on twigs of spruce from central China, which is very distinct in form from all other described species.

The cottony maple scale (*Pulvinaria vitis* L.) is not so prevalent as it has been during the past three or four years; in fact, it seems to have almost entirely disappeared from some of the regions which were so seriously infested in 1905. The cottony maple-leaf scale (*Pulvinaria acericola*) has been reported as occurring in injurious numbers in portions of West Virginia, Tennessee, and Georgia; but, judging from the large percentage of parasitism, it will soon be reduced in numbers.

EXPERIMENTAL WORK WITH INSECTICIDES.

The experimental work with insecticides is now distributed for the most part under the different special investigations of the Bureau, and will be reported under these subdivisions. The general scope of the work may be here briefly indicated. In deciduous fruit insect investigations the work done or in progress includes a continuation of tests with the lime-sulphur wash, more particularly as a summer treatment for trees infested with the San Jose scale, tests of fumigants for scale-infested apples for export purposes, tests of various arsenicals as to their effect on foliage and toxicity against insects, and tests of various contact insecticides, such as whale-oil soap, kerosene and distillate emulsions, tobacco extracts, etc., against various insects, more particularly the pear thrips in California and the cranberry insects in Wisconsin; also tests of various paints and washes against the peach borer and the fruit-tree barkbeetles.

In the investigation of the enemies of tobacco in the dark-tobacco regions of Kentucky and Tennessee various methods of spraying with arsenites have been made the subject of experiment and field demonstration.

In the cotton boll weevil work, insecticidal treatment was long since demonstrated to be of minor importance. Nevertheless some work with insecticides is carried on each year; and during the past season demonstration work has been carried out in the Red River Valley in northern Louisiana to test the claims of success which were there being made. The results were entirely in accord with the previous findings in Texas.

Some little insecticide work has been done in the branch of cereal and forage-plant insect investigations, more particularly looking to the local stamping out of colonies of the "green bug." In the main, however, there is little opportunity for insecticide work in this field, and insect control must be secured by farm methods.

The principal detailed insecticide work of the season is probably that carried out in connection with the white fly investigation in Florida, and the species investigation of gassing in California. The results of this work are reported in another place.

In connection with other special lines of work of the Bureau, more or less insecticide work has been done in the investigation of truck crops and insects affecting ornamental and shade trees.

In the work with forest insects, again, the control must be in the main secured by the adoption of the proper methods of lumbering. Direct applications of insecticides are rarely if ever practicable.

The number of proposed new insecticides which come to this Bureau for examination or report rather increases from year to year than otherwise, under the stimulus of special problems such as the boll-weevil and "green bug" problems. These supposedly new insecticide discoveries are reported at an average rate of two or three a day, and some of them require examination, but most of them are readily judged from a mere description. Not one in a hundred of these presents any novel or useful idea. During the last fifteen years only two new and useful insecticides have developed. These are arsenate of lead and the more recently discovered so-called miscible oils or system of rendering certain petroleum products directly miscible with water.

INVESTIGATION OF HYDROCYANIC-ACID GAS FUMIGATION IN CALIFORNIA.

This project was taken up in the beginning of the fiscal year at the request of several of the horticultural commissioners of California and at the instance of Members of Congress representing the citrus districts. A scientific examination of the gassing methods by the United States Government was desired to place the system on an exact basis and to obviate if possible the occasional damage to trees and fruits which follows current practice. A thorough study was made of the existing methods, and this was followed by the institution of large-scale experiments covering as rapidly as practicable all of the different features of the problem, namely, to discover the best formulas and mechanical methods and the particular dosage for the different insects involved and for trees at different conditions as to blooming or maturity of fruit. Most hearty and active cooperation has been had with the State and county horticultural officials and prominent citrus growers.

The especially difficult scale pest to control in California is the purple scale (*Lepidosaphes beckii* Newm.), and a special series of orchard tests on a considerable scale was carried out against this insect in the vicinity of the town of Orange. Check fumigation experiments against this same insect were instituted at other points. It was shown that a dosage of 1½ ounces of cyanid of potassium to each 100 cubic feet of space inclosed by the tent would destroy all of the purple scale on the leaves and branches. A heavier dosage, however, is required to kill the insect on the fruit, and the eggs are even more difficult to destroy than the insects. Much better results were secured by extending the time of fumigation to an hour rather than with thirty or forty minutes, the customary period.

In this work a good deal of time has been given to determining the exact nature of the combination of the chemicals used in producing the gas and in studying the proper proportion and methods of generation. The gas is generated by combining cyanid of potassium and sulphuric acid in equal proportions with three parts of water. In determining the rôle of these different ingredients, the subjects especially studied have been: (1) The exact action of the sulphuric acid; (2) the action of water; (3) the effect of different proportions of water on the temperatures of the liberated gas; and (4) the effect of different proportions of water on the amount of available gas. Valuable data have been gained under each of these special topics.

A very important feature of the problem is to determine the effect of fumigation on the plant. Experimental fumigations were conducted with the orange trees at different dates to test the effect of fumigation on trees in bloom and with fruit of different sizes. In no instance, even at heavy dosages, was there any evidence of injury to trees fumigated when in bloom. The really critical period for fumigation proved to be, however, in the case of trees full of young fruit. Trees with young fruit heavily fumigated for the purple scale exhibited injury or loss of nearly 50 per cent of the fruit, and indicated that fumigation, when the fruit is less than one-fourth grown, is impractical. The fumigation operations generally in progress in California during the winter were carefully inspected, and in several instances were cooperated in, gaining results over the whole field and against all classes of citrus scale insects occurring in southern California. A preliminary report is in preparation.

Incidentally in connection with this work studies have been made of the scale-insect enemies of citrus trees in California from the standpoints of life history and habits and of control by parasitic and other enemies. The most interesting outcome of this phase of the investigation has been the demonstration of the abundant parasitism of the red scale (*Chrysomphalus aurantii* Maskell), a scale pest of first importance, which was hitherto believed to be remarkably free from parasitism.

WORK ON INSECTS INJURIOUS TO STORED PRODUCTS.

During the fiscal year under consideration a series of investigations has been undertaken on the insects injurious to stored cereals in the mills of the South, on the request of many milling companies in Kansas, Oklahoma, Missouri, and Texas, and on behalf of the steamship owners and operators of Galveston, Tex., and New Orleans, La. This work has been placed in charge of Dr. F. H. Chittenden, who has had general supervision over the investigations of insects injurious to stored products.

A preliminary investigation was begun in January, so that a good beginning was made before the receipt of special requests for this line of investigations, which did not come in until late in February. One of the special subjects called for in this project is a study of the flour beetles, which injure prepared cereals, especially such as are manufactured in Kansas and Missouri and shipped through New Orleans for European ports. The underwriters who insure against this damage claim, with reason, that flour shipped southward in the warmer months through the warm climate of the Gulf ports is much more liable to damage by these insects, and report that many thousand sacks of flour have been shipped by that route to various European ports within the year and were seriously damaged, and that, therefore, a strong prejudice exists against shipping flour by way of our Gulf ports.

Conditions were observed in all possible locations in New Orleans, Houston, Galveston, Corpus Christi, Brownsville, San Antonio, and other localities in southern Texas, and at Matamoros and Monterey, Mexico. Numerous specimens were taken in nearly every locality and new localities were established for several species. It was ascertained that the large elevators of Galveston were badly infested with the rice weevil, and that nearly every car coming from northern Texas, Oklahoma, and Kansas contained many grain-feeding insects. One of the most important steps ascertained as a preliminary to future investigation was, as to what particular species of insects are injurious in the infested localities, which are primary and which are secondary pests, and which are neutral or beneficial. Specimens are forwarded to this Bureau for identification, and some of our correspondents assist. The results of the last few months are somewhat surprising. Both of our two most injurious flour beetles are found to be rather generally distributed and abundant in mills. A decade ago practically the only flour beetle known to be injurious in the Southern States was the rust-red flour beetle (*Tribolium ferrugineum* Fab.), which was then not injurious northward, though occasionally seen in isolated localities. One of these is the District of Columbia. Thus far it has proved one of the most injurious of all of these very troublesome pests. Since 1893, however, it has been ascertained that the confused flour beetle (*Tribolium confusum* Duv.) is the dominant species in the North, where the milling industry is more extensive. Here it is a pest second only to the Mediterranean flour moth. It was then confined to the North, and now it has invaded the Southern States, and there is a possibility that it may displace the former. Incidentally, it should be mentioned that the flour moth is also increasing its range rapidly, and is well established as far south as Texas, having been introduced inde-
y from other regions. At first it was a pest only in Canada.
y of this species constitutes a separate and very important

Three other species of flour beetles are implicated in these troubles, none of them, however, being thus far as injurious as the first two mentioned. They are the broad-horned flour beetle (*Gnathocerus cornutus* Fab.), the small-eyed flour beetle (*Cænocorse* (*Palorus*) *ratzeburgi* Wissm.), and the related *Cænocorse subdepressa* Woll.

Still another species is apt to be extremely injurious, owing to its habit of boring through grain bags and even into wood, affording entrance for other injurious beetles. This is a grain borer, *Rhizopertha dominica* Fab. (*Dinoderus pusillus*), a species not hitherto known to be permanently established in this country, although frequently shipped here in boxes of rice and other cereals.

When a more rigid policy of cleanliness is practiced, and rolling stock is kept moving rapidly, and transfers are properly made, so that there may be no unnecessary delays, these flour beetles are comparatively few in numbers; but many empty cars have enough beetles in them among the remains of flour, grain, and other cereals in the corners and cracks to infest the next cargo of similar material and to afford opportunity to the various species to be constantly breeding. The pier sheds and warehouses at the seaports visited also have numerous insects, especially in neglected spots. Flour stored for any length of time in the southern seaports is practically certain to be infested in a very short time by one or more injurious species. Fortunately most cargoes do not have to wait long for shipment, and much of the flour is transferred directly from car to vessel.

The subject of packing material used in exporting cereals of various kinds received attention some years ago, but it was found necessary to take up this matter again. There is room for considerable improvement in the quality of the sacking. The grain borer last mentioned is capable of entering almost any material, but the other insects do not, as a rule, trouble cereals that have the proper grade of sacking. The heavy muslin jutes and "osnaburg," a heavy grade like canvas, will exclude the flour beetles under ordinary conditions, unless the seams are stretched or are injured by rough handling, which sometimes happens, e. g., when hooks are used.

More or less damage to flour en route and abroad is apt to occur in that which is shipped during warm weather. The same will happen if the material is stored in heated storerooms. A few insects undoubtedly obtain access to the sacks at certain mills, or eggs may be deposited on them, enabling the young insects to crawl through small cracks in the sacking. This, however, should not, and probably does not, often happen in well-regulated flouring mills. If cars are not carefully cleaned before loading with flour, they may become infested en route to the Gulf ports. If stored upon the piers for even a few days during a warm season they are very likely to become infested.

The rice weevil (*Calandra oryza* L.) is practically always present in infested wheat, corn, and some other grains, attaining its greatest destructiveness through the Gulf region, where it breeds in the field. It is also very destructive throughout our grain-growing country with the exception of the most northern regions. Some additional study of this as well as other grain beetles is desirable.

In all nearly thirty distinct species have been found in the infested mills of the region visited, including one species of flour beetle not hitherto known to occur in this country. It has been located only in limited areas in Texas and Kansas, and its habits must be studied to ascertain whether or not it is likely to prove an important pest. In this number, however, are some species which are merely scavengers, while some few are predaceous and some are parasitic, this last class, therefore, being beneficial.

Tests are being made of the efficacy of hydrocyanic-acid gas as a fumigant for infested flour mills and warehouses; demonstrations are being given of the value of bisulphid of carbon (the standard and best remedy for stored-product pests in general) in mills, elevators, granaries, and cars, and the value of cold storage, and sulphur dioxid as a fumigant will be tested where possible. Information in regard to methods of applying these remedies has already been furnished to all millers and others who have made complaints in regard to injuries and have requested it.

INVESTIGATIONS OF INSECTS AFFECTING TOBACCO.

As indicated in the last annual report, in the bill making appropriations for the Department for the fiscal year in question a clause was inserted providing for investigations of insects injurious to tobacco in the dark-tobacco belt of Tennessee and Kentucky. Unwilling to wait until the beginning of the fiscal year before commencing this apparently important investigation, the Bureau sent an expert assistant to the region in May to make a preliminary examination of the field. Later, at the beginning of the fiscal year, an agent was stationed in the region concerned. In this important tobacco area the loss, mainly from insects, during the spring and summer of 1907 amounted to at least $2,000,000. A considerable share of this was due to unprecedented damage in plant beds by the tobacco flea-beetle. There is, however, a more or less regular annual damage by this and other insects, bringing about a very considerable money loss. Upon undertaking the work, the agent in charge made a careful survey of the whole dark-tobacco region. He became familiar with the special insect problems and the places most favorable for experimental and demonstration work, and selected Clarksville, Tenn., as headquarters. Suitable laboratory facilities were provided, together with such apparatus as was needed. The practical part of the work, however, was done under the usual field conditions. The general attitude of the planters was found to be most friendly to the work, and the interest was so great that there was no difficulty in arranging whatever experimental field facilities were desired. The tobacco is taken from the fields and placed in the barns in the latter part of August and September, and therefore, after the necessary travel by the agent in charge, there was little time left for experimental operations. Nevertheless, experiments were conducted to determine the most effective insecticides and the best method of application. It was ascertained that arsenate of lead is probably much more effective than the preparations that have been used and that it can be applied more economically. Attention was also paid to control by cultural means, and the possibility of reducing the damage of the northern and southern tobacco worms by such means was taken up systematically. It was considered that the planting of certain crops, such as crimson clover, on land from which tobacco had just been taken, in connection with the necessary plowing, would cause the destruction of many of the tobacco-worm pupæ in the soil. Therefore a number of observations and experiments were instituted to determine what advantages could be expected by this procedure. The average number of pupæ per acre was determined by digging up a considerable area in old tobacco fields, and experiments were then started to determine the depth of plowing necessary to destroy the pupæ. Special stress was placed upon demonstration work in connection with this investigation. On account of the unavoidably late start it was impossible to do much of it, however. Some was instituted at Clarksville, and this will lead during the coming fiscal year to much more extended demonstrations of practical control on various plantations throughout the dark-tobacco belt. The investigation has the hearty support of the Tennessee State Experiment Station and the work is also being carried on in harmony with the Kentucky Experiment Station.

INSPECTION WORK.

The large amount of plant material, including seeds, bulbs, rhizomes, roots, bud-wood, grafts, etc., introduced by the Department from many foreign regions necessitates a rigid entomological inspection to prevent the introduction and establishment of noxious insects. During the past year careful inspection by Mr. J. G. Sanders of all material imported by the Department has resulted in the discovery of many noxious insects, some of which are new to science, while some are almost cosmopolitan.

The most notable lot of material inspected has been received from central China, collected by Mr. F. N. Meyer, agricultural explorer for the Department.

Several undescribed species of scale insects were discovered in the various sendings, and several species of weevils, especially of the genus Bruchus, were found infesting the many varieties of soy beans and cowpeas imported from that country. Curiously enough, several common European insects were also found in the various lots of material from central China; particularly among the scale insects were *Eulecanium capreæ* (L.) and *E. prunastri* (Fonsc.). *Diaspis pentagona* was found on nearly every sending of plum and cherry along with *E. prunastri*. A new species of Physokermes was found on spruce (*Abies* sp.); also a new species of Aspidiotus. In seeds of *Rosa* sp. were found larvæ of the European Hymenopteron *Megastigmus collaris* (Boh.), from which many adults issued in April, of which 3 were males and 55 females. In seeds of a hybrid pear × Cratægus from Christiania, Norway, were found several Hymenopterous larvæ, which, after six months' pupation, emerged as adults in May and were determined as *Syntomaspis druparum* (Boh.). This insect has been previously bred in New York State from seeds of Cratægus. A large shipment of alfalfa seed from North Turkestan was found to be badly infested with minute Hymenoptera, *Bruchophagus* sp., near to or perhaps *funebris*.

Several new species of mites, determined by Mr. Nathan Banks, of this Bureau, were found in various bulbs and tubers from China and from South Africa.

A new genus of Scolytidæ was found in seeds of Mucuna from Jamaica. Two new species of Cocotrypes were found—one in seeds of *Bassia latifolia* from Sibpur, India, and the other in seeds of *Rollinia octopetala* from Para, Brazil. An apparently undescribed species of Bruchus was found in seed pods and seeds of licorice from central China. A Crambid moth near *Chilo phragmatella* and a large species of Sphenophorus were bred from stems and roots of the large Egyptian rush, *Cyperus exaltatus*, collected in the Nile region. Specimens of the Dipteron *Merodon constans* (Rossi) were bred from gladiolus bulbs from Transvaal.

All material shipped from the Department is given a rigid inspection, and thorough fumigation, if necessary, before leaving the Department greenhouses. Three hundred and ninety-six certificates have been granted in the last year covering these shipments.

WORK IN BEE CULTURE.

The work of the Bureau in bee culture, under the charge of Dr. E. F. Phillips, has been enlarged, and its operations have been more than usually productive during the past fiscal year.

WORK ON BEE DISEASES.

The chief problem considered again during this year was the investigation of the brood diseases of the honey bee. This is the most important line of investigation which can be undertaken at present for the benefit of the bee industry. The annual loss from these diseases, conservatively estimated at $2,000,000, may undoubtedly be considerably reduced by the application of better methods of manipulation. The investigations so far conducted deal largely with the micro-organisms that cause disease or are found in diseased material. Last year the cause of the American foul brood was definitely determined. The cause of European foul brood has not been definitely ascertained by inoculation experiments, but the various micro-organisms found with it have been carefully studied. Ordinary laboratory media do not serve the purpose, and new ones have been sought for.

Investigations have been made of the applications used in foul brood. A frequent recommendation is a 5-per-cent carbolic-acid solution, but it was found that the causative organism of American foul brood will not die in such a solution in thirty days. In this way faulty methods have been eliminated. Samples of diseased brood were received from all portions of the United States, and reports were sent out as to the nature of the trouble. The geographic distribution of the different diseases is being definitely determined and the present data at hand are often of use in assisting in the passage of inspection laws in the different States. Careful experiments have been carried on in regard to the mechanical measures for treating diseased colonies. In this direction, as in so many others, it will be apparently impossible to exterminate these diseases so long as all bee keepers can not be induced to adopt measures, but it seems possible for men commercially interested to run their apiaries regardless of the carelessness of the smaller bee keepers. As in so many other industries, the man interested in bee keeping to only a small extent seems to be in many cases a detriment to the industry. An effort is being made to induce bee keepers to refrain from using the same combs year after year. Bees rapidly rebuild their combs, and by the sale of the wax a sufficient profit will be made to warrant the measure, which will not only eradicate disease, but will control swarming and cause the bees to work more vigorously.

RACES OF BEES.

The distribution of the breeding material, carried on in 1906–7, was not continued during the summer of 1907, and it does not seem desirable for the Bureau to continue it longer at present. Breeding material of any race now used in this country may be easily obtained at no great cost direct from the native home of the race. If any new desirable race is found, the situation of course will be changed. The Banat race, from Austria-Hungary, is being tested in two apiaries near Washington, D. C., by the Bureau, and the colonies in the Bureau apiary are kept pure Caucasian as far as possible, this race being particularly desirable in an apiary devoted to experimental work.

HONEY ANALYSIS.

As was stated in the last annual report, a large number of samples of honey of known origin was obtained and turned over to the Bureau of Chemistry for analysis and investigation. The results of this work were incorporated in a bulletin of the Bureau of Chemistry which will be of great benefit to the bee-keeping industry. Following the appearance of this bulletin a publication was issued from the Bureau of Entomology on the production and care of extracted honey, outlining the best methods of manipulation and calling attention to the proper way to care for honey, in preparing it for the market, so that its value will not be impaired. The parts of the samples not used in analysis have been preserved, and form the beginning of a collection of American honeys which will be increased as rapidly as possible.

STUDY OF THE STATUS OF BEE KEEPING.

As mentioned in the last annual report, an effort was made to learn the condition of the bee-keeping industry in Massachusetts. It was found that Massachusetts produced in one year the insignificant amount of 72 tons of honey, whereas from its area and honey resources several times that amount should be expected. Evidence was found in nearly every county of the presence of one or both of the brood diseases. This is unexpected and significant, since two years ago the statement was made by the leading bee keepers of Massachusetts that no disease existed in that State. Efforts are being made now to provide for State inspection of apiaries.

Similar work has been taken up during the fiscal year in Maryland and Virginia, in collaboration with the Bureau of Entomology, while in North Carolina and Tennessee somewhat similar work has been done independently of this Bureau.

BEE KEEPING IN HAWAII.

During the fiscal year the expert in charge took a trip to the Hawaiian Islands, at the request of the Hawaiian Bee Keepers' Association, to make a survey of the industry on the islands. Apiaries were inspected on all of the large islands, and it was found that none of the infectious bee diseases existed. Recommendations were made as to the methods of quarantine to be established. The dark-colored honey which is produced so abundantly on the islands comes from the excretion of the sugar-cane leafhopper. This must be sold as "honey-dew honey," according to the decision of the pure food law. While the bee keepers of Hawaii are perfectly willing to comply with any just regulations, such as they recognize this to be, they find it difficult to educate their customers to the honey, and therefore desire to dispose of it in some other way. A method was outlined whereby the amount of honey might be decreased and the quantity of wax increased. The islands are as yet far from being fully stocked with bees, but if the apiaries are run for wax production instead of for honey, it will be possible to occupy locations otherwise inaccessible, since wax may be carried down mountain trails by pack mules. There is also considerable available territory near the coast where honey may be carried out by boat.

OTHER INVESTIGATIONS.

Further studies have been made of the important subjects of mating queens in confinement; of honey plants (in cooperation with the Bureau of Plant Industry), and of the activity of a colony, with a view of gaining information regarding the cause of swarming, the conditions during winter, etc. Investigations have also been made on the subject of bee enemies.

During the year the apiary of the Bureau was moved from the Arlington Farm to the grounds of the Maryland Agricultural College at College Park, Md. The present location is better for the work, and the forage is better for the bees. The substation in California, first located at Chico and later moved to Riverside, was discontinued in November, 1907. There is plenty of work in California which should be done, but it does not at present seem desirable to maintain a station so far from Washington. It seems better and more economical to send men to the field when necessary to work out special problems.

WORK IN SILK CULTURE.

No changes have been made in the methods that have been followed for some years in the effort to encourage the production of silk in this country. The interest shown in the subject has, in the main, kept up, and the correspondence has been about as great as it was during the previous fiscal year. The principal interest has been shown in New York, Pennsylvania, California, Georgia, Nebraska, and New Jersey, in the order mentioned. An especial effort has been made in California to put the industry on a solid basis, and it seems a notable fact that the period of financial depression following the panic of October, 1907, gave an impetus to silk culture as one of the smaller industries promising small profit, but still worth while.

PURCHASES OF SILKWORM EGGS AND THEIR DISTRIBUTION.

Seventy-five ounces of bacologically examined eggs were imported from Italy for distribution to applicants in the spring, and though received rather later than is customary, were still found to be in good condition. These eggs included 12 ounces of pure races and 63 ounces of crossed races. Eggs were also sent for trial from an Italian firm. In distributing the eggs the quantity sent to each applicant was from one-sixteenth of an ounce to an ounce or more, depending upon the amount of food, facilities, and experience possessed by the applicant. Experimental rearings were made at the Department of Agriculture at Washington.

DISTRIBUTION OF MULBERRY STOCK.

As in previous years, seedlings of the best white mulberry (*Morus alba* var. *Roseo di Lombardia*) were distributed to all applicants during the late fall and spring, none being sent out during freezing weather. This season all shipments consisted mainly of lots of 50 to 100, with occasionally ones of only 25 or of several hundred. Aside from these, one shipment of 1,000 was sent to Ohio. Aside from the larger shipments, more than 16,000 seedlings were sent out, nearly twice the number distributed during the previous fiscal year.

Three kilograms of mulberry seed were purchased from Italy to form a basis for future distribution. This seed was turned over to the Arlington Experimental Farm of the Department of Agriculture for cultivation, in the same manner as has been done in previous years. Owing to the lack of silk appropriation for the next fiscal year, the ultimate plans for the distribution of these seedlings are undecided. The larger quantities were sent to States in the following order: Texas, Ohio, California, North Carolina, Massachusetts, Virginia, Georgia, Nebraska, Missouri, South Carolina.

THE PURCHASE OF COCOONS.

The number of pounds of cocoons purchased from American raisers during the year was nearly three times as much as was purchased during the previous year, and with few exceptions the quality has been excellent. Much credit should be given to silk producers throughout the country for the excellent methods they now employ in preparing cocoons for the market. In all, 285 pounds were purchased. The larger quantities and the best of these came from New York, Kansas, Connecticut, Massachusetts, New Jersey, Ohio, and Texas.

REELING OPERATIONS.

The reeling operations have been carried on as in previous years. Owing to the shortage in the cocoon crop, the reel was not run during 1907 before August, when two operators were employed. In September this number was increased to five and continued until the middle of March, 1908. Owing to repairs in the buildings, reeling was not begun again until June 8, when it was continued until the end of the fiscal year. During the portion of June when the reels were in operation each reeler was given a pound of cocoons per day and five threads were run.

MISCELLANEOUS WORK.

Of investigations which have not previously been considered, and which will be treated under the heading "Miscellaneous investigations," are some lines of work which are quite important and which entail a great amount of correspondence, but which are somewhat secondary to the projects that have already been considered.

WORK ON INSECTS INJURIOUS TO SHADE TREES.

The project of investigations on shade-tree insects is quite distinct from that on forest-tree insects. Even if the same species occur both on forest trees and on shade or ornamental trees, the methods of controlling them are radically different. Investigations which have been conducted in previous years along this line and the excessive injury accomplished during recent years have made it necessary to prepare several publications on certain important pests. For example, during the year two circulars of information, Nos. 96 and 97, of the Bureau of Entomology, on the catalpa sphinx and bagworm, respectively, have been issued and distributed. Similar publications are in the course of preparation on other important insects injurious to shade and ornamental trees, including such prominent pests as the imported willow curculio, the green-striped maple worm, and several forms of pernicious borers. The first of these is increasing its distribution year by year and is threatening nursery stock in many States in the North.

INSECTS INJURIOUS TO FLOWER GARDENS AND IN GREENHOUSES.

Similar heavy correspondence is conducted every year on the vast number of insects injurious to ornamental plants other than trees. Many new forms are coming under observation as pests, and similar publications are being prepared, giving information in regard to the most troublesome forms, with particular reference to the best directions for their control. A few publications, which, however, do not begin to meet the demand, have already been prepared, and two new ones will soon be issued on the rose slugs or " worms " and on the red spider, the latter a general pest in the greenhouse, flower and vegetable gardens, field, and vineyard.

WORK ON INSECTS INJURIOUS TO THE PECAN.

Investigations of insects affecting the pecan industry, which have been made a special study during the past two years, especially in Florida, have been given additional attention during the last fiscal year. Special work was done on the fall webworm (*Hyphantria textor* Harr.) and the black walnut caterpillar (*Datana integerrima* G. & R.), both of which are partially controlled in the pecan groves of the South by parasitic natural enemies. The borers also received special study. Some important species, not hitherto studied by the Bureau of Entomology, were given considerable attention, including two Sesiids, as well as other species with different habits. One of these was found most abundantly in an old seedling grove of about 40 acres in Georgia, where the trees were so badly infested that most of the buds were girdled and killed within the year after being set. The orchard is apparently doomed.

The pecan budworm, the twig girdlers, the prominent caterpillar, the phylloxeræ, the pecan leaf-miner, the walnut sphinx, the case-bearers (*Acrobasis* spp.), and a considerable number of other species were studied in Florida and Georgia as well as in Texas and, through the assistance of some of our agents and special correspondents, in other States. The work in the last two States is still preliminary in character, but some of the species studied are unrecorded, having not previously come under observation.

OTHER INVESTIGATIONS.

The insects injurious to acorns have been given continued study, as in two previous years, and the results are already available for publication. In this work considerable cooperation has been secured.

With the beginning of the growing season quite a number of new pests, or old pests in new rôles, have been reported, and the work of rearing and studying the habits of these insects in the insectary has been such that our accommodations have had to be greatly enlarged. Roughly estimated, the number of species now under observation is double that of the previous year.

The time devoted by specialists to the identifying of specimens of insects for entomologists of State experiment stations and workers in similar lines has also greatly increased over last year, and many consignments of specimens remain to be determined. This takes up a considerable portion of the time of many men in winter, who may be employed in the field during the summer months, but it is a very important and necessary work, without which we can not secure scientific or exact results. The correspondence of the Bureau continues to increase, and has necessitated the employment of a considerable addition to our clerical force.

The increased cooperation with the Bureau of Plant Industry and other branches of the Department and with entomologists and others connected with experiment stations and with working economic entomologists is a source of great satisfaction. Good results are being obtained through cooperation with individuals, many of whom volunteer or accept our proffer of cooperation. This is particularly valuable in distant localities, where we are unable as yet to locate field agents or collaborators. With little doubt at the present rate of increase this cooperation will soon be very extensive and will be productive of excellent results of practical value to the farmer.

PROPOSED WORK FOR THE FISCAL YEAR 1909.

At the time of the present writing the work for this fiscal year is well under way, and for the most part consists of a continuation of the lines of investigation just indicated. With the cotton boll weevil, the reduction in the amount of money available for this work, from a special emergency appropriation of $40,000 to an allotment of $20,000 from the lump fund appropriated for entomological investigations, has naturally changed the scope of the work materially. Five of the most efficient investigators developed in the previous work are being continued. It will be possible to carry on field work on only a limited number of projects. These have been selected from those most indicative of practical results. The plan of experimental farms will be continued, although the number and size have been reduced. There will be six of these in Texas and one in each of the States of Louisiana, Arkansas, and Oklahoma. One of the most important lines of work under way is the utilization of the parasites and predaceous enemies of the weevil. Much attention will be paid to introducing new forms into Louisiana and Mississippi, although continued studies will be carried on in Texas to ascertain sources of supply as well as better methods of handling. The chain drag or cultivator, referred to in an earlier paragraph, will be given a thorough practical test. Six machines have been manufactured and located on as many plantations, where they will be used throughout the season. This work has been arranged in such a way as to show the advantages from a cultural standpoint as well as from the standpoint of the control of the weevil. The check-row system of planting in its relation to weevil control will also be studied. Experimental machines to assist in the fall destruction of the plants will be constructed. Other projects that have been taken up are the agitation of the utilization of cotton stalks on account of the great advantage of fall destruction of the plants in controlling the weevil, the possible use of chemical means under some conditions for the fall destruction of the plants, the flooding of fields in the lower Mississippi Valley, and the possibility of danger from the alternate food plant on which the weevil was found feeding during the preceding year in Louisiana. In addition to this work an attempt will be made to ascertain the exact general status of the boll weevil from time to time. All of this work will be done on a considerably smaller scale than heretofore. The routine work of testing proposed remedies will, of course, be continued.

The appropriation for preventing the spread of the gipsy moth and the brown-tail moth was increased by the last Congress from $150,000 to $250,000 and the appropriation was made immediately available. During the present fiscal year the work of the previous year will be continued on a larger scale with larger forces of men, and additional features will be taken up in each of the infested States. The widespread stripping of forest trees in the woodlands of Massachusetts during June and July, 1908, calls for more attention than has been possible previously, and during the coming winter some woodland work will be done in the way of creosoting egg masses. The egg masses in plain sight over very large areas can be destroyed without too great expense. This will not be an attempt at extermination, but an effort to keep the caterpillars from swarming in such numbers as to threaten the life of the forests. Unquestionably many larvæ will occur in such woodlands another season, but this in a way is desirable rather than undesirable, since it will leave an abundant opportunity for the increase of the introduced parasites. The spraying of trees with arsenate of lead along the roadsides will be continued through the feeding season of 1909. This will necessitate the purchase of additional spraying machinery. Extensive scouting work will also be carried on during the winter. The gipsy moth is now known to occur in about 266 cities and towns of 5 States, with a probable addition to this number in Massachusetts and New Hampshire which will probably be ascertained by the coming scouting. In several of these cities and towns the gipsy moth has in past years been a serious pest, but to-day it is not present in sufficient numbers to cause appreciable damage. It has not been exterminated in large areas, but has been held in such subjection by the work of communities or individuals that there is neither inconvenience to the residents nor damage to the trees or crops. This is the condition to which the entire territory should be brought by the repressive work in question and by the work of the introduced parasites.

Parasite work will be continued throughout the year. The agent sent to Japan sent in much important material during the first month of the year (July, 1908), and additional material is constantly being received both from Japan and from parts of Europe. The eggs of the brown-tail moth will be received during the summer, the gipsy moth eggs during the autumn, and the brown-tail nests in the winter. With the opening of the summer of 1909 larvæ of both brown-tail and gipsy moths will be sent in. An assistant will be sent to France during the early autumn of 1908 to study the methods used in the parasite shipping station at Rennes for the purpose of introducing there the latest methods evolved in the laboratory at Melrose Highlands. In the early summer of 1909 it is not likely that an agent will be sent to Japan, since the trip of 1908 resulted in the organization of a force of voluntary observers and correspondents who will renew the supply of parasites received this year. Depending largely upon the report of the assistant sent to France during the coming autumn, an arrangement may be made whereby an expert assistant of the Bureau will be stationed at Rennes during the breeding and shipping season of 1909, and in the spring of that year the Chief of the Bureau will probably visit Europe again to consult with the different agents and to establish new points of supply.

The work against forest insects will be carried on in much the same way as in previous years, the only novel feature being the sending of an expert of the Bureau throughout forest regions in order to get in close touch with the practical owners and managers of forests and manufacturing interests, including State foresters, to encourage them to utilize the available information on practical methods of preventing losses. Much of the time of the experts in this line of work will be devoted during the year to the working up for publication of the mass of original data accumulated during the past six years.

In the work against deciduous fruit insects, it is proposed to continue the several field stations as now located, with the exception of those at Lakeside, Ohio, and Tecumseh, Nebr. Tests for summer washes for the San Jose scale are to be continued, and it is planned to extend the fruit fumigation work to include other fruits than the apple, such as pear and orange. The work against the grape rootworm and the grape berry moth will be continued throughout the present season, and the study of miscellaneous grape insects will be started in the spring of 1909. The work against cranberry insects and codling moth and the demonstration spraying will be continued on the same lines as during the fiscal year 1908. The work against the pear thrips in California is to be materially enlarged. A power sprayer will be purchased and an additional assistant will be assigned to the station at San Jose in time to assist in the work in the spring of 1909. Experiments and demonstrations will be carried out in orchards in both Santa Clara and Contra Costa counties, where the pest is abundant and destructive. The possible value of irrigation and cultivation in the control of the thrips is to be given special attention.

The work on insects affecting field crops and truck and vegetable crops will be continued on about the same lines, and the same may be said with regard to the white fly work.

With regard to the insects affecting stored products, the investigation mentioned in regard to the spread of these injurious species by means of common carriers will be thoroughly carried out. The importance of this line of investigation has been thoroughly indicated by the work during June, 1908. Steamship lines and railroads are unconsciously permitting and even assisting the work of these insects. This can probably be prevented by the adoption of economical measures.

In the tobacco insect investigations the work has been enlarged by the detail of a second assistant, and the Tennessee Experiment Station has furnished a third trained man for summer work. The headquarters will be continued at Clarksville, Tenn., and cooperative demonstration work has been arranged on nine plantations in the dark-tobacco region. Special attention will be given to the parasites of the principal tobacco worms, and an attempt will be made to introduce an egg parasite from Porto Rico, with the assistance of the entomologist of the Porto Rico Experiment Station.

A new line of work has been undertaken during the fiscal year at the suggestion of the Office of Farm Management in the Bureau of Plant Industry. That office has determined the possible great importance of cacti as food for stock in the semiarid regions, but in their experimental plantings insect injury became at once conspicuous and so extensive as to threaten the successful outcome of the experiments. It has therefore been planned to ascertain, so far as possible during the coming fiscal year, what insects feed upon the various species of cacti that may be used for live-stock food, to study their life histories and habits, and to devise means of control, if possible.

In bee-culture work bee diseases will continue to be the main problem of investigation. All the other lines indicated in previous paragraphs will be followed up during the winter, various methods of extracting wax from combs will be tested, and, if any reliable method is found, it is possible that an experiment in wax production on a commercial scale by running a large apiary for wax during the summer of 1909 will be begun. This problem, as explained in a previous paragraph, is very closely connected with the problem of bee diseases.

Since Congress omitted mention of silk culture in the bill appropriating for the fiscal year 1909, this work has been abandoned and the silk-reeling machine has been loaned to the Bureau of Science at Manila, P. I. The records and other material used in the work will be cared for in case at some future time it seems desirable to take up these investigations once more.

SUGGESTIONS AS TO WORK RECOMMENDED FOR THE FISCAL YEAR ENDING JUNE 30, 1910, FOR USE IN PREPARING ESTIMATES.

The Bureau does not wish to appear grasping in money matters. There is no desire on the part of its officials to get from Congress any more money for its investigations than can legitimately be used to the ultimate practical advantage of the country. As the investigations are carried on, new opportunities for advantageous work in the direct line of some special investigation are frequently seen, and the necessity for new lines of work is constantly becoming obvious. To follow up these investigations necessitates the employment of additional assistants and the appropriation of funds for additional supplies for experimental and laboratory work and for traveling expenses. The gradual increases in the appropriations to the Bureau within the past few years have been productive of excellent results and have enabled its investigators to show more and more clearly that money spent in promoting their investigations means money saved to the country. For the fiscal year 1909 the lump sum of $158,800 was appropriated for entomological investigations. In view of the facts above stated it seems a very moderate request to ask for an appropriation of $225,000 for the fiscal year 1910 for general entomological investigations; and this request is respectfully made.

A striking example of the necessity for increased appropriations may be specified in the pear thrips of California, and this is only one of a number that might be cited. The seriousness of the ravages of that insect in California and the certainty of its spread in that State, together with the possibility of its introduction into eastern Massachusetts, warrant work on a considerably larger scale than the present funds of the Bureau will permit. For the present fiscal year only about $5,000 has been allotted to the project, and for another year available funds should be sufficient to permit the allotment of at least $15,000 to that work.

The results obtained in the work of preventing the spread of the gipsy and brown-tail moths have been excellent. The appropriation has been spent economically and effectively. An appropriation of the same amount ($250,000) during the fiscal year 1910 could be administered to the same advantage. It must be stated, however, that with an additional sum proportionately better results could be reached, and it appears to the Chief of the Bureau that the magnitude of the danger would surely justify the appropriation of an additional sum of $50,000, making the amount to be expended for this purpose $300,000 during the fiscal year 1910.

In regard to salaries, there seems no necessity for a further increase in the number of positions upon the statutory roll, but an increase in salary for one of these positions is strongly urged. The Secretary of Agriculture last year recommended an increase in the salary of the chief clerk of the Bureau from $1,800 to $2,000, but upon this recommendation Congress took no action. It is urged that the salary of this official be increased from $1,800 to $2,250. The position under the present organization is an onerous one and one of great responsibility. It is also respectfully urged that the salary of the Chief of Bureau be increased to $5,000. The importance and scope of the work conducted in the Bureau are such as to justify this increase.

REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., September 1, 1908.

Sir: I have the honor to transmit herewith a report on the work of the Biological Survey for the fiscal year ended June 30, 1908, with outline of work for 1909.

Respectfully,
C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE BIOLOGICAL SURVEY.

The work of the Biological Survey as laid down by Congress is conducted under three general heads: (1) Investigation of the economic relations of birds and mammals to agriculture; (2) investigations concerning the geographic distribution of animals and plants with reference to the determination of the life and crop belts of the country; (3) supervision of matters relating to game preservation and protection, and the importation of foreign birds and animals.

ECONOMIC ORNITHOLOGY AND MAMMALOGY.

The study of birds and mammals in their economic relations assumes yearly more importance. The extension of agriculture to supply the needs of a constantly increasing population and to provide foodstuffs for export, the application of improved irrigation methods for the utilization of vast tracts of waste land, the introduction of new insect pests—these and other factors materially affect the distribution of animal life and disturb the balance of nature. Hence an accurate knowledge of the food and other habits of birds and mammals is necessary to the end that the beneficial kinds may be protected and the injurious kinds controlled.

The many problems in economic ornithology calling for investigation concern a large and increasing class of nature lovers and sportsmen and a still larger and vastly more important class, the farmers, on whose welfare ultimately rests the prosperity of the country. The various questions relating to the protection of insectivorous and game birds form important subjects of legislation in every State, and accurate information must be forthcoming as a basis for the enactment of proper laws. So important is the preservation of certain species of migratory birds, especially ducks, geese, and shore birds, that ultimately the several States concerned may deem it expedient to intrust the legislation and police powers necessary for the protection and preservation of such species to National authority.

Experiments to determine the best and most economical methods of destroying wolves, coyotes, rabbits, ground squirrels, rats, and mice have been continued during the year.

WOLVES AND COYOTES.

Wolves and coyotes combined cause an annual loss to the stockmen and farmers of this country of several million dollars, and in some of the Northern States wolves threatened to exterminate the deer over considerable areas, both of wild and preserved land. Most of these losses are believed to be preventable, provided intelligent and concerted action on the part of farmers and stockmen can be secured. Early in 1907 a bulletin and two circulars containing directions for trapping and poisoning wolves and coyotes, and for finding their breeding dens, were widely distributed in the wolf-infested States, with the result that during the year many more of the animals were killed than previously. The total number of wolves killed was over 1,800, while about 24,000 coyotes were destroyed. The estimated saving of stock effected is not less than $2,000,000. During the present year another circular (No. 63), bringing the subject up to date, has been distributed for the purpose of renewing interest in the work and still further diminishing the number of the pests.

It is thought that in some sections at least the surest and most economical method of protecting stock, especially sheep, against the assaults of wolves and coyotes is by means of wire fencing, and several experiments having this end in view have been tried. During the present season, at the request of the Forest Service, specifications were drawn for a wolf- and coyote-proof fence to inclose an experimental sheep pasture in the Imnaha National Forest, Oregon. After completion, the fence was inspected by an assistant of the Survey and found to be well constructed. Reports upon the efficiency of this experimental fence are about to be published by the Forest Service.

FIELD MICE.

During the year an extraordinary infestation of field mice occurred in the neighborhood of Lovelocks, Nev., recalling in the extent of damage done the disastrous plagues of field mice in Europe, hitherto happily absent in this country. The alfalfa crop in the Humboldt Valley was badly damaged, and in places absolutely ruined, so as to necessitate replanting. The mice first ate the stalks and leaves and then devoured the roots. The damage to crops in the region infested for one year is estimated at some $250,000. This is an earnest of what may be expected when the irrigation projects now in hand are completed, and thousands of acres of desert are brought under water and made to produce crops. This same species of meadow mouse inhabits a wide region, and only awaits favorable opportunity to multiply and become a scourge.

When the necessary cooperation of the farmers of a community can be obtained, prevention is comparatively easy and cheap. Where, however, field mice are allowed to multiply, as in Nevada, until on certain ranches they reach the startling total of 10,000 to 12,000 to the acre, the reduction of their numbers to a point of safety is very difficult and expensive.

The Nevada outbreak furnishes an important object lesson as to the value of certain birds and mammals to the farmer. As soon as the mice began to increase markedly, hawks, owls, ravens, gulls, and herons among birds, and badgers, skunks, weasels, foxes, and coyotes among mammals hurried to the scene and made the pursuit of mice the chief object of life, most of them in fact subsisting entirely on the mice. It was estimated that during the height of the outbreak the birds and mammals enumerated destroyed some 45,000 mice daily. Although their combined assaults unaided did not suffice to abate the plague, yet when the number of mice was reduced by poison, and long before it approached the normal, they were able not only to prevent increase but to cause a rapid decline, which continued until the mice became so scarce that the predatory birds and mammals were forced to scatter and look elsewhere for food. It is fair to infer that had these friends of the farmer been protected in the beginning they would have been able from the first to hold the mice in check, preventing the abnormal increase so that there would have been no plague.

A preliminary report on field mice has been already published. A special report on the Nevada outbreak will soon be ready, followed by a general article on field mice, discussing the danger of their excessive multiplication, the nature of the damage they do to crops, especially alfalfa, and the best methods of reducing their numbers.

HOUSE RATS.

The entire civilized world is awakening to the importance of waging a war of extermination on rats. Wherever the subject is investigated the amount of damage done by these rodents is found to reach an appalling total—a total which justifies the expenditure of large sums in checking the waste. Accurate statistics of the injury done by rats and mice in the United States have heretofore been wanting. In January and February of the present year careful investigation was made of the losses in the cities of Washington and Baltimore. About 600 firms and individuals engaged in handling foodstuffs or other merchandise were interviewed. In Washington the losses sustained by merchants, marketmen, grocers, and proprietors of other business establishments were estimated at $200,000; and the losses to private citizens in residences were found to be approximately the same, bringing the total, including the sums spent in fighting the pests, up to $400,000. In the much larger city of Baltimore conditions proved to be very similar, and the total loss there was estimated at $700,000.

Assuming the conditions in these two cities to be typical, the losses in cities of 100,000 population or upward throughout the United States reach a total of $20,000,000. This takes no account of the losses in towns, villages, and the smaller cities, or of the losses on poultry and eggs and on grain and other crops, which aggregate fully $30,000,000 more—in all, upward of $50,000,000 a year.

This is serious enough, but it is by no means the most serious aspect of the rat question, for rats are now known to be active disseminators of plague and other fatal diseases, and Professor Koch considers them "the chief agent in the diffusion of plague;" on which account they are much more to be dreaded than as destroyers of property.

In San Francisco and other maritime cities the boards of health, assisted by the United States Public Health and Marine-Hospital Service, are at the present time prosecuting active war against them, but, unhappily, without marked success. The Biological Survey also has continued its experiments with various means of destroying rats, without the discovery, however, of any single agent or method which can be recommended as effective under all circumstances. Professor Kitasato tells us that in Japan, where the number of rats killed each year sometimes reaches a total of a million, "nevertheless at the present day no appreciable diminution in the number of the rodents can be noticed. Reproduction keeps pace with destruction, so that we are at a loss to know how to proceed." For the present, at least, comparative immunity from these dangerous rodents is to be obtained only by employing several more or less effective methods, as traps and poisons, and by continued cooperative effort on the part of communities.

DEER FARMING.

The game animals of the United States are rapidly diminishing in numbers, and, whereas venison was formerly abundant and cheap, to-day it is seldom to be found except on the tables of the wealthy. This diminished supply is largely the necessary result of the cultivation of large areas of land not long since inhabited by wild animals. The setting aside of tracts of the public domain to conserve our rapidly diminishing forests and as refuges for valuable and interesting forms of animal life is therefore wise and timely. It is evident, however, that further steps are necessary if venison is to cease to be a mere luxury and is to become a food available for all.

The rearing of elk and other kinds of deer in confinement for conversion into venison, and even their domestication, appears to offer no greater obstacles than the rearing and domestication of cattle. The most serious impediment to the success of the business is State game laws. These naturally have been framed for the sole purpose of protecting wild game; hence the provisions respecting the killing, transportation, and sale of game animals are such as to practically prohibit the raising of deer for venison, and, in some States, even their sale for purposes of propagation. It is believed, however, that a complete understanding of the purposes of deer farming, especially a realization of the fact that it is one of the surest methods to insure the continued existence of the several species of the deer family, will result in so modifying existing laws as to permit the marketing of venison raised in confinement under such regulations as in no wise to jeopardize the safety of wild game.

As a result of investigations by the Survey, including correspondence with persons who have already made a success of raising deer, a bulletin has been issued setting forth briefly the advantages of deer farming and giving details necessary for undertaking the business for profit. Not the least important purpose is the utilization of tracts of land unsuited to agriculture, but well adapted to deer farming. It is believed that the dissemination of information on the subject will result in the establishment of an important industry, profitable alike to the individual and to the State.

FOX FARMING.

From earliest times fur-bearing animals have formed an important part of the resources of the United States. Their skins constituted an essential part of the winter raiment of the aborigines, and later proved no less important to white men, both as wearing apparel and as a source of profit. So persistently have the fur-bearers been pursued and so greatly have their former homes been encroached upon by civilization that they are now comparatively scarce and are constantly diminishing. The finer furs are already so costly as to be beyond the reach of the many, and the supply even of the less desirable kinds by no means equals the demand. Foxes furnish an excellent quality of fur, that of the silver fox being especially fine and bringing a high price. Though rearing foxes in confinement can scarcely be said to have advanced beyond the experimental stage, enough has been done in this direction to prove that under proper conditions and in the hands of skilled men several kinds, including the silver-black fox and the blue fox of Alaska, can be reared in captivity profitably and with little difficulty.

Considerable data in relation to the business have been obtained, and a bulletin has been issued setting forth the conditions under which the industry is likely to be successful, and describing the best methods of pursuing it. It is believed that, without seriously interfering with their other occupations, many farmers in the northern part of the country can give sufficient time and care to the raising of foxes to insure ample returns for the time and capital required.

EXAMINATION OF BIRD STOMACHS.

Field investigations and laboratory examinations of the food of birds are carried on simultaneously for the double purpose of ascertaining exactly what each bird eats and of furnishing field assistants valuable hints as to the birds most profitable to study.

A few years ago our knowledge of the food of birds was dependent almost wholly on field observations. However carefully made, these prove quite inadequate as a basis to definitely fix the economic status of a given species, whether beneficial or injurious to agriculture. For this, careful examination and accurate determination of the contents of birds' stomachs are necessary. The present force engaged in this work is entirely inadequate to the magnitude of the task, and can do little more than keep abreast of current work, leaving the large accumulation of past years untouched. The economic status of a given bird, when once determined for a given region, is fixed for all time, at least in essentials, since changes in the food habits of birds are rare and occur chiefly when new plants and insects find their way into the country. It is hoped that in the near future the force now employed in this important field may be augmented, so that the large amount of material now on hand can be studied and the results published for the benefit of farmers, orchardists, and others. During the past year 3,073 stomachs were received from various sources, and 3,387 (including some already on hand) were examined and their contents determined.

RELATION OF BIRDS TO THE COTTON BOLL WEEVIL.

Investigations of the relations of birds to the cotton boll weevil were continued in Louisiana, and several additional species were found to feed on the insect, bringing the number of birds now known to eat the weevil up to 54. Some species appear to eat it only casually, as it happens to come in their way. Others appear to be fond of the beetles and to make special search for them. Thus titlarks prove to be active destroyers of the beetle in winter, 34 out of 68 birds examined having eaten a total of 120. Varying thus in the number they destroy, all are important—some more, some less—in checking the increase of the weevil, which is one of the most noxious of our insect pests. A supplementary report on the subject has been issued, which, together with the circulars and reports of previous years, has been widely distributed in the districts already infested by the weevil, and also in the region of its probable extension.

It is highly probable that ultimately the pest will invade every foot of the cotton-producing area, and it is important that an accurate knowledge of the part birds play in checking its increase be widely disseminated in advance. It is not too much to expect that the laws of every cotton-producing State shall protect all birds which eat the boll weevil; and it is of even greater importance that every farmer in the cotton States shall be fully informed as to the nature and extent of the services such birds render, particularly as the numbers of some of the more important species may be increased by affording them protection and added opportunity for nesting. If their numbers are materially augmented in the territory not yet invaded by the pest, they may not only to some extent delay the spread of the insect, but later will permanently keep down its numbers.

CALIFORNIA BIRDS IN RELATION TO THE FRUIT INDUSTRY.

For several years investigations have been carried on in California to determine the exact relations of birds to the fruit industry, that the orchardists may learn to discriminate between the useful and injurious kinds, to the end that they may protect the useful kinds and adopt preventive measures against the others. Part I of a report on the subject was completed last year and widely distributed, and the manuscript of Part II has been finished and is now nearly ready for the printer.

FOOD OF WILD DUCKS.

Investigations of the food of wild ducks continue, with the view of securing information upon which to base legislation for establishing a proper open season for this important group of food birds. Great difficulty is experienced, however, in securing an adequate amount of material. Some progress was made in the work during the year, and more than 1,100 duck stomachs are now on hand, almost all of which have been examined and the contents identified.

FOOD OF WOODPECKERS.

In 1895 a preliminary report was issued on the food of woodpeckers. Though the material in hand at that time was far from sufficient, valuable conclusions were reached, the evidence justifying the conclusion that woodpeckers are indispensable in the work of forest preservation. Since then every effort has been made to secure additional material, and now nearly five times as many stomachs are on hand as were available twelve years ago. Examination of the contents of these is now being made with a view to a final report on the subject.

MOSQUITO-EATING BIRDS.

The discovery of the part mosquitoes play in spreading such diseases as malaria and yellow fever has naturally called attention to these little pests and to economical methods of exterminating them. That some birds eat mosquitoes has long been known, and recently it has been found that more species eat them than was formerly supposed, and that certain species eat them in such numbers as to constitute an important check on their increase. Accordingly the subject is being studied with a view to determining what birds lend the most valuable aid; among the number are now known to be the chimney swift, nighthawk, northern phalarope, and killdee. Since the nighthawk and killdee are sometimes shot for food, their mosquito-eating habits should be widely known so that the birds may be protected. Further investigations in this field will be necessary, particularly in the Southern States, before a report can be made.

BIRDS IN RELATION TO THE CODLING MOTH.

Preliminary data on the relations of birds to the codling moth show that no fewer than 22 species of our native birds feed on this destructive insect, to the spread of which they constitute an important check. Further studies will be made of the part birds play in lessening the numbers of this pest.

GROSBEAKS.

Work on the economic relations of the grosbeaks begun in 1905 was completed in 1906, and a report on the subject was issued and distributed during the fiscal year 1908, thus making available for public use a knowledge of the food habits of this group of useful birds.

SPREAD OF THE ENGLISH SPARROW IN SOUTHERN CALIFORNIA.

Special work was done in California in checking the spread of the English sparrow. Prior to 1906 the English sparrow was unknown in southern California, but in the autumn of that year a small colony was reported at Newhall, Los Angeles County. The five southern counties of the State (San Bernardino, Orange, Riverside, Imperial, and San Diego) are still free from the bird, and the conditions in Los Angeles County are favorable for its destruction before it has become established. Taking advantage of a visit to Los Angeles in August, a representative of the Survey visited Newhall in company with the county game warden. The colony there proved to be a small one and all sparrows that were seen were killed. The attention of several of the residents of the place was called to the presence of the bird and the necessity for checking its increase.

Later the bird was reported at Lancaster, Palmdale, Saugus, and one or two other points on the Southern Pacific Railroad north of Newhall, and at Victorville, in San Bernardino County, on the line of the Santa Fe road; and on May 31, 1908, the county game warden found a few English sparrows in the city of Los Angeles. The following day, at the request of the warden, the matter was laid before the county board of supervisors by the Department's representative, and attention was called to the importance of destroying the birds already in the city before they could spread to the neighboring fruit-growing districts. An appropriation of $250 was voted immediately by the board for beginning the work of stamping out the pest.

Considering the interest already aroused in the presence of the bird in southern California and the prompt action of Los Angeles County, it should be possible without much difficulty to check the further increase of the species in this region. The western extension of the Mohave Desert between the parallel ranges of mountains on the north and south prevents the bird from spreading southward very rapidly from the San Joaquin Valley, and the rugged ranges of mountains in Santa Barbara and Ventura counties also tend to check its spread coastwise. If the small colonies south of Tehachapi and Ventura, less than half a dozen in number, and the outlying colony reported at Victorville are destroyed, the English sparrow can probably be excluded indefinitely from the great fruit-raising section of southern California.

MEANS OF ATTRACTING BIRDS.

The importance of insectivorous birds in the continual warfare necessary against insect pests is now generally recognized, and most of them are everywhere protected by law. It is inevitable, however, that the rapid utilization of our wild land and the consequent diminution of our forested areas will result in greatly diminishing the numbers of certain species by destroying their breeding grounds and diminishing their food supply. It is important to counteract these and other injurious influences by making other provision for the welfare of our birds. One of the easiest and most important measures is providing an increased food supply by planting about houses and gardens fruit-bearing trees and shrubs, such as mulberries, wild cherries, and others. Such trees serve a threefold purpose: They are ornamental, provide food for useful species, and serve to protect valuable fruit from attacks by birds. A report on the subject has been delayed by pressure of other work, but, pending publication, information as to the best kinds of trees and shrubs for the purpose under various climatic conditions will be furnished on application.

GEOGRAPHIC DISTRIBUTION.

As in former years the Survey has conducted extensive field work for the purpose of gathering information concerning the distribution, abundance, and habits of our native birds and mammals. The results serve as a basis for mapping the life zones of the United States and also the distribution of the species. In addition to these important data the assistants in this branch of work accumulate much information concerning the food habits and relative abundance of the various species. This knowledge is essential for a proper classification of the species into beneficial and harmful groups. The wide acquaintance of the field naturalists of the Survey with the animal life of the country and with the habits of the various species is of great value in devising means of combating the injury to agriculture by the noxious species.

The investigations in this branch of the work during the year have been varied and have covered widely scattered parts of the country. Dr. C. Hart Merriam continued his work on the life zones of California and added materially to the data already accumulated. Vernon Bailey spent several months in southern California, and visited Oregon and North Dakota, collecting material for mapping the life zones of these States, and gathering information on the economic relations of birds and mammals. He also visited Humboldt Valley, Nevada, and made a preliminary investigation of the plague of field mice on the alfalfa ranches of that section, and the damage by burrowing rodents to the irrigation ditches of the Carson-Truckee irrigation project. As a result of this and previous work a bulletin was prepared on the harmful and beneficial mammals of the Carson and Humboldt valleys of Nevada. Later Mr. Bailey inspected the experimental wolf-proof sheep fence built by the Forest Service on the Imnaha National Forest, Oregon.

Merritt Cary completed the biological survey of Colorado, and his map and report on the work are nearly ready for publication.

W. H. Osgood spent July and August in northern New England and eastern Canada, making a survey of that region and gathering information for a report on fox farming, which has been published as Farmers' Bulletin 328. E. A. Preble completed the report on his work in Canada, which is now being published as North American Fauna No. 27. H. C. Oberholser completed for publication a report on the Economic Relations of the Birds of Texas. A. H. Howell made a trip to Louisiana to study the relations of birds to the cotton boll weevil. E. A. Goldman was employed from July, 1907, to February, 1908, in studying the distribution and economic relations of birds and mammals in central California. W. W. Cooke continued his study of the migrations of birds and completed for publication a bulletin entitled Distribution and Migration of North American Shore Birds.

During the year the office of Geographic Distribution has made considerable advance in mapping the distribution of American birds and mammals, and in getting its accumulated data into shape for convenient reference and use.

GAME PROTECTION.

The United States, with its great tracts of wilderness, its large and diversified supply of game, and its varied climates, furnishes many attractive hunting grounds. Its big game embraces deer of several kinds, moose, elk, caribou, antelope, mountain sheep, and mountain goats; and its winged game includes the ruffed grouse, blue grouse, prairie chicken, and several other members of the grouse family, the quail, the wild turkey, the woodcock, snipe, various shore birds, and myriads of waterfowl. The pursuit of these numerous and varied species of game offers to our own citizens a healthful and enjoyable recreation, and attracts sportsmen from other parts of the world. The number of hunters annually in the field probably exceeds 3,000,000. With this army of sportsmen scouring the country and with the wilderness constantly decreasing through the encroachments of civilization, the problem of game preservation becomes yearly more difficult, and the duties of the office of Game Protection correspondingly grow in importance and complexity.

Difficult problems attach also to the task of preserving the non-game birds of the country. Capture of native birds for millinery purposes and for the cage-bird market is under fairly good control; but questions that press constantly for settlement arise through absorption of breeding haunts to meet the needs of spreading civilization, the great increase in the number of persons who shoot birds, and other agencies of depletion resulting from changed conditions.

In dealing with these problems several lines of activity are followed. Solutions are sought through enforcement of the Federal law prohibiting interstate commerce in game and birds which have been illegally killed, cooperation with State authorities and protective organizations in securing suitable State laws and enforcing those on the statute books, acquisition and publication of information bearing on the needs of game and bird preservation, and the performance of such other functions, active and advisory, as occasion requires.

Another phase of activity results from the duty imposed by the Lacey Act of supervising importations of live mammals and birds. Perpetual vigilance is required to prevent the introduction of species likely to prove ineradicable pests and so bring about a repetition of the disastrous results that followed the acclimatization of the English sparrow. Efforts to import and liberate dangerous species are not infrequent—several were made during the past year—and the success of even one attempt would probably entail serious losses, such as have occurred in other countries less carefully guarded. While, therefore, certain branches of the Department add large sums to the annual profits of agriculture, the careful check maintained by the Survey is a service less obvious but no less important, for it prevents losses amounting to many thousands of dollars a year.

The special work along these various lines during the past year will be considered under different heads.

IMPORTATION OF FOREIGN MAMMALS AND BIRDS.

In the supervision of importation of mammals and birds into the United States such consignments as offered opportunity for the entry of prohibited or dangerous species were closely scrutinized by inspectors of the Department stationed at New York and Philadelphia, the main ports of entry, and, so far as known, no violation of the law occurred. An attempt was made to import two specimens of mongoose (*Crossarchus fasciatus*) at New York on January 6, but entry was denied, and the animals were reshipped to Bremen, Germany. In February an application was received for the entry of 120 Hungarian hares, some of which were intended for crossing with Belgian hares, while others were to be used in stocking game covers. Many species intended to be kept in captivity are admitted that are denied admission when intended to be liberated; European hares are in this category; hence the consignment in question was not permitted to enter until assurance was given by the importer that none of the hares would be set free. In the same month entry was denied of a consignment of song thrushes which it was designed to liberate on Coney Island, and also of a shipment of 200 skylarks imported for liberation in Santa Cruz County, Cal. During the year 103 consignments were inspected, of which 99 were entered at New York and the remainder at Philadelphia. An additional inspector was appointed at Honolulu to act during the absence of the regular inspector, and the inspection service at that port was placed on the same basis as that at New York and Philadelphia, the Department paying a fee of $5 for each inspection.

The total importations of the year under permit comprised 305,595 canaries, 14,694 game birds, 42,915 miscellaneous birds, 1,520 mammals, and 592 eggs of game birds. The increase in game birds was 4,579, mainly due to the large number of European partridges imported for stocking covers, 7,781 being brought in, as against 3,075 in the preceding year. Among the rare pheasants imported for aviaries were 2 Bornean firebacks, 4 Siamese firebacks, 18 tragopans, 2 Formosan pheasants, and 2 "Sultan" pheasants (from Turkey and probably a local variety of the English pheasant, *Phasianus colchicus*). So far as known to the Department, this is the first time the Formosan and "Sultan" pheasants have been imported. The more important miscellaneous birds included 2 bower birds, 3 brush turkeys, 2 crested screamers, 2 drongo-shrikes, and 15 Brazilian bellbirds. The number of eggs of game birds imported showed a decided falling off; this year's importations were exceeded by last year's by 5,318. During the year there were imported without permit 19,690 canaries, 6,072 parrots, 4,596 miscellaneous birds, and 438 mammals. The total importations from July 1, 1907, to June 30, 1908, were, therefore, 325,285 canaries, 68,277 other birds, 1,958 mammals, and 592 eggs of game birds.

Personal examination was made of conditions at the principal ports on the Pacific coast. Seattle and Tacoma, Wash., now have several direct steamship lines to the Orient, but the bird trade there is still inconsiderable. As soon as this trade increases to any extent the services of a special inspector will be required in one or both of these cities.

BIRD RESERVATIONS.

Within the year the President has set aside nine additional bird reservations. The date of establishment, name, and location of each of these are as follows:

Aug. 8, 1907	Tern Island Reservation	Louisiana.
17, 1907	Shell Keys Reservation	Louisiana.
Oct. 14, 1907	Three Arch Rocks Reservation	Oregon.
23, 1907	Copalis Rock Reservation	Washington.
23, 1907	Quillayute Needles Reservation	Washington.
23, 1907	Flattery Rocks Reservation	Washington.
Dec. 7, 1907	East Timbalier Island Reservation	Louisiana.
Feb. 24, 1908	Mosquito Inlet Reservation	Florida.
April 6, 1908	Tortugas Keys Reservation	Florida.

Of these reservations Tern Island, Shell Keys, and East Timbalier Island consist of small uninhabitable islets along the coast of Louisiana, frequented by large numbers of terns, gulls, brown pelicans, and man-o'-war birds. Three Arch Rocks Reservation comprises a group of small unsurveyed basaltic islands off the coast of Oregon, tenanted by gulls, cormorants, puffins, guillemots, and oyster-catchers, and by dense colonies of murres. In the past, birds on these islets have been wantonly shot by visiting excursionists, but hereafter visitors will be allowed only under permit. The Washington reservations embrace about 130 rocky islets of no agricultural or commercial value, lying along the coast from Grays Harbor to the Straits of Juan de Fuca. They are inhabited by such birds as are found on Three Arch Rocks Reservation and, in addition, a large number of auklets and petrels. Their total population is estimated to consist of 100,000 petrels and 60,000 other birds. A few small herds of sea lions add to the attractiveness of the fauna. Mosquito Inlet Reservation, Florida, is a feeding place for several kinds of birds, including the pelicans of Pelican Island, a few miles to the north. It is composed of small mangrove and salt grass islets, shoal sand bars, and sand spits in and near the mouths of the Halifax and Hillsboro rivers, Florida. Tortugas Keys Reservation comprises the group known as the Dry Tortugas, near the western extremity of the Florida Keys, and is a breeding ground of sooty, noddy, and least terns, frigate birds, and other species. Its designation as a bird reservation does not interfere with its use for military purposes.

Reports from the warden of Pelican Island Reservation indicate a steady increase of the bird life of that island. The pelicans began arriving October 7, a month earlier than usual, and by February numbered 8,000 adults and 2,000 young. There was considerable mortality among the latter owing to unfavorable weather, and fully 500 died of cold and exposure. Early in April nesting was resumed, and a second brood of 600 or more was successfully raised. The island was visited by seven parties of tourists during the spring.

The attention of the Bureau was called to illegal shooting of birds on Chandeleur Island, a light-house station near Breton Island Reservation. The matter was taken up with the Department of Commerce and Labor, which revoked a permit to fish on Chandeleur Island, held by the offender, and directed the light-house keeper not to permit him to land thereafter.

PROTECTION OF GAME IN ALASKA.

A new Alaska game law was passed at the recent session of Congress and was approved by the President on May 11, 1908. The principal changes provide for hunting licenses, export licenses, and guide licenses, to be issued by the Governor of Alaska, who reports the details of the issue of such licenses to the Secretary of Agriculture; provide for support of the enforcement system by annual appropriations to be made on estimates submitted by the Secretary of Agriculture; and authorize the Governor to appoint game wardens. Under the law as it now stands, the Department continues to issue permits for scientific collecting and for export of specimens for propagation, exhibition, or scientific purposes, but those who desire to hunt for sport in Alaska or to export trophies from the District must apply to the Governor for the necessary license.

The number of permits issued by the Department for the export of trophies up to the date of approval of the bill was 34; 16 permits were also issued during the year for collecting and exporting scientific specimens, so that the total number of permits was 50.

INFORMATION CONCERNING GAME.

An important feature of the work connected with the preservation of birds and game is the collection and dissemination of information concerning game and nongame birds, many requests for which were received during the year.

Game Laws of the United States and Canada.—The usual summary of provisions concerning close seasons, shipment, sale, licenses, and bag limits was issued as Farmers' Bulletin 308 and was widely distributed among sportsmen and others interested, especially in those States which have no compilation of their game laws. The great demand for this summary attests its usefulness. The large posters giving the close seasons in the United States and Canada in tabulated form were also issued and widely distributed as usual.

Game Protection in 1907.—In the résumé in the Yearbook of the year's progress in game protection, particular attention was given to the condition of the game of the country, which, generally speaking, was very encouraging. The increase in the importation of partridges and pheasants from Europe was mentioned, and sportsmen were advised to devote their efforts to increasing native game birds rather than to importing foreign species, the ultimate value of which is problematical. Attention was called also to the growing practice of raising game in confinement and the need of laws permitting the marketing of such game under restrictions that will prevent the illicit sale of wild game.

Stocking Covers.—Much information was gathered from breeders, dealers, and game preservers concerning the propagation of game birds, the number and species of birds raised, the methods followed, and the degree of success attained. Importations of eggs for hatching were followed up, and the results obtained through this method of introducing game birds were ascertained. Such information is in frequent demand by correspondents and will be needed in the preparation of publications now in contemplation.

Game Preserves.—The collection of data relating to the private game preserves of the United States was continued, and much information was gathered for future use, especially concerning the numerous duck preserves in California. Attention was paid also to the game preserves of other countries, from which many useful points of comparison with our own may be drawn.

Thanksgiving Game.—Data concerning prices and abundance of game in the markets immediately preceding Thanksgiving Day were collected as usual. The material on hand now covers four years, and furnishes an excellent index to the relative prices and abundance of game.

History of Game Protection in Michigan.—Data were gathered for a résumé of the history of game protection in Michigan from the earliest times to date, and this is now being prepared for the press.

Quail Disease.—Little additional information has been obtained regarding the disease which made its appearance two years ago among quail in transit for restocking covers. This dearth of new knowledge is due mainly to almost complete discontinuance of such shipments, chiefly because of laws prohibiting such export from the States which have been the chief source of supply, but partly because of the uncertainties introduced by the prevalence of the disease. Several reports of the appearance of disease among wild quail were investigated, but were found to be without foundation.

COOPERATIVE WORK.

Much work was done as usual in cooperation with other Departments, State game officials, and game and bird protective organizations. A meeting of the association of game wardens, held in the Yellowstone National Park in August, 1907, was attended by the chief of the office of Game Protection. These gatherings of the chief game officials of the various States are of great importance to game protection, and in view of the close relationship between this subject and forest protection and the present tendency on the part of State legislatures to place both under one head, the Forester, at the suggestion of this office, directed officials of five National Forests to attend as representatives of the Forest Service. At the instance of this office the association adopted a resolution looking to cooperation between the National Association of Game Wardens and the American Breeders' Association, with a view to facilitating the propagation of game.

In cooperation with the Bureau of Chemistry experiments were begun to determine the effects of cold storage on certain kinds of game. For this purpose a number of ducks of different species were obtained from North Carolina, with the aid of the secretary of the North Carolina Audubon Society, and a few prairie chickens were secured from Nebraska, through the courtesy of the chief deputy game and fish commissioner.

Two visits were made to Trenton, N. J., by a member of the Survey for the purpose of giving expert testimony before the Governor and the Senate committee on fish and game relative to the danger of continuing the spring shooting of waterfowl and summer shooting of woodcock, both of which practices are exceedingly detrimental to the several species concerned.

Aid was rendered game officials in California, Idaho, Illinois, North Dakota, Texas, Washington, Wisconsin, and Wyoming in various cases arising under the game laws of these States, and the Virginia Federation of Women's Clubs was assisted in the preliminary steps for the organization of a State Audubon society in Virginia.

TUSK HUNTING IN YELLOWSTONE PARK AND VICINITY.

Important cases were referred to in the last report arising from the killing of elk for their heads and teeth in the Yellowstone National Park and vicinity. After their conviction in April, 1907, at Pocatello, Idaho, on the charge of shipping heads and horns from Idaho to California in violation of the Lacey Act, two of the hunters, William Binkley and Charles Purdy, were immediately rearrested and held for trial at Fort Yellowstone for violation of the Yellowstone Park act in killing elk within the park limits. At the trial, which was held on September 10 before the United States commissioner, Binkley and Purdy were convicted and sentenced to pay the costs in the case, amounting to $933, and to serve three months in jail. On November 14 indictments were secured at Cheyenne, Wyo., for Oscar Adams and Charles Isobel, the other two members of this noted gang of tusk hunters. These two men have not been apprehended, but the vigorous action of the Government has had the desired effect of breaking up these poaching operations, previously a menace to the game of the region.

ROUTINE WORK.

As the field work of the Survey increases and includes new lines of investigation, the amount of routine work increases correspondingly. This consists of correspondence; the preparation and editing of reports and bulletins on special subjects for publication; the identification and labeling of specimens, including those collected by our own assistants and also those sent in for identification by colleges, museums, and various individuals; the storage and care of field collections; cataloguing and identifying the contents of bird stomachs; tabulating field reports; sorting and filing published matter for future reference; mapping distribution of birds, mammals, and plants; supplying the needs of field assistants; developing photographic plates and making prints therefrom; compiling game laws; issuing permits for the entry of foreign mammals and birds, and for the export of trophies and specimens from Alaska; and cooperation in enforcing the various provisions of the act of Congress of May 25, 1900. The letters received during the year numbered about 7,166; the letters written during the year numbered 6,111, and the migration schedules sent out to observers, 734. During the year 930 negatives were made, illustrating and furnishing a most valuable supplementary record of the field work of the Survey. The series now numbers about 10,600 negatives.

OUTSIDE DEMANDS.

The above may be considered part of the regular duties of the Survey. In addition to these are constant demands for financial statements relative to field and office expenditures, the number and complexity of which are ever increasing; and requests from other Government Bureaus, and from special commissions, committees, and boards for reports on subjects apart from the duties of the Survey, but more or less distantly connected with them. These two classes of demands annually require the expenditure of much time and labor on the part of the Chief and his principal assistants, and constitute a heavy draft also on the small force of clerks. The subject is mentioned here in explanation of the fact that much time is annually consumed in the elaboration of results which do not appear as part of the output of the Survey. As no extra clerical assistance is provided, and no appropriation made for the expenses attendant on this extra service, it constitutes a heavy tax on the regular funds and necessitates the curtailment of other important work.

PUBLICATIONS.

The publications for the year include 5 bulletins, 1 Farmers' Bulletin, 4 Yearbook articles, 4 circulars, the Report of the Chief for

1907, and reprints of former publications. The bulletins are: No. 28, Game Commissions and Wardens, by R. W. Williams, jr.; No. 29, Relation of Birds to the Cotton Boll Weevil, by Arthur H. Howell; No. 30, Birds of California in Relation to the Fruit Industry, by F. E. L. Beal; No. 31, An Economic Study of Field Mice, by David E. Lantz; No. 32, Food Habits of the Grosbeaks, by W. L. McAtee. The Farmers' Bulletin is No. 308, Game Laws for 1907, by T. S. Palmer, Henry Oldys, and C. E. Brewster. The articles in the Yearbook for 1907 are entitled: The Rabbit as a Farm and Orchard Pest, by David E. Lantz; Does it Pay the Farmer to Protect Birds, by H. W. Henshaw; The Game Resources of Alaska, by W. H. Osgood; and Game Protection for 1907, by Henry Oldys. The titles of circulars are: No. 61, Hawks and Owls from the Standpoint of the Farmer, by A. K. Fisher; No. 62, Directory of Officials and Organizations Concerned with the Protection of Birds and Game, by T. S. Palmer; No. 63, Destruction of Wolves and Coyotes, Results Obtained during 1907, by Vernon Bailey; No. 64, Destruction of the Cotton Boll Weevil by Birds in Winter, by Arthur H. Howell.

The reprints of former publications issued are as follows: Bulletin No. 29, Relation of Birds to the Cotton Boll Weevil; Circular No. 32, second edition, revised, Directions for the Destruction of Prairie Dogs; Circular No. 60, revised, List of Publications of the Biological Survey.

OUTLINE OF WORK FOR 1909.

ECONOMIC ORNITHOLOGY AND MAMMALOGY.

Work on the food habits of birds and mammals will be continued along much the same lines as in previous years.

RELATION OF BIRDS TO THE BOLL WEEVIL.

As the boll weevil extends its range eastward from Texas through Louisiana, Mississippi, and other cotton-producing States, it will encounter new conditions, and it is important to study the effect of the insectivorous birds of the regions invaded on its progress. Accordingly it is intended during the coming season to continue investigations of the relations of birds to the pest, particularly in Louisiana, a considerable part of which State has already been entered by the weevil.

BIRDS IN RELATION TO THE FRUIT INDUSTRY.

Part 2 of a report on the relation of birds to the fruit industry in California is now nearly ready for the printer. The investigations carried on in middle California will be extended northward into the northern part of the State and into Oregon and Washington. In both the latter States fruit raising has assumed large proportions, while comparatively little is known of the birds living in or near orchards and of the nature of their food.

ENGLISH SPARROW.

Supplemental investigations in relation to the English sparrow are being carried on and will be continued during the coming year. Hitherto the pest has not invaded southern California to any extent, and an attempt is being made, in conjunction with local and county officials, to exterminate it in the few places where it now is, with the purpose of preventing it from gaining a foothold in the fruit-raising sections of this region, where, if it becomes numerous, it is certain to do immense damage.

STARLING.

The starling, which was introduced into Central Park, New York, a number of years ago, has spread from that point as a center southward to northeastern Pennsylvania and northern New Jersey, eastward to central Connecticut, and northward up the Hudson River, thus occupying portions of four States. An attempt will be made this year to ascertain the exact distribution of this bird, the rapidity of its spread from New York, its relative abundance at the various points it now occupies, and the character of its food habits. This information is essential to devising means to check further increase of its range and to eradicate the pest, as far as possible, in the territory now occupied.

DIKE BORERS.

Experiments undertaken last year in Nevada to check the damage to irrigation dikes and embankments by burrowing rodents were highly successful, and the methods developed have been tried and pronounced by engineers to be simple and effective. It is intended to continue these in other irrigation districts and where necessary to send skilled assistants to demonstrate the methods recommended.

HOUSE RATS AND MICE.

World-wide efforts are now being made to abate or greatly lessen the nuisance of these pests. Though everywhere a steady tax on almost every product of human industry, their destruction is sought less on this account than because they constitute a menace to human health by carrying disease germs. The most effective remedies yet devised against them are various traps and poisons, which, however, have the disadvantage of requiring persistent use to be effective. The superiority of a bacterial preparation which, when fed to the animals, will cause a contagious disease, may readily be perceived. Several preparations declared to be of this kind have been placed on the market. Some of these have already been tested by the Survey and found wanting in the chief essential—communicability from rat to rat; others will be experimentally tested in the hope of ultimately securing a more efficient agent for use against these most noxious rodents.

FOX FARMING.

A Farmers' Bulletin on the subject of the rearing of the silver fox has been published, and the demand for it, as well as for further information on the subject, indicates a widespread interest in the business. So far the few breeders of the silver fox have been actuated solely by a desire for speedy returns from their investment, and hence have paid little or no attention to the improvement of breeding stock. Neither have satisfactory experiments been made as to the best food for foxes in confinement, the best method of handling breeding animals, and kindred subjects.

It is hoped that funds will be forthcoming to permit the establishment of an experimental farm where the animals may be handled to the best advantage and scientific methods may be employed in developing improved stock, not only of this fox but also of other valuable fur bearers. The information thus obtained will then be disseminated through publications with a view to instructing small farmers in the details of a business which, if properly pursued, can not fail to be remunerative.

DEER FARMING.

A great demand for the Farmers' Bulletin recently issued by the Biological Survey on Deer Farming shows the widespread interest in the subject; and numerous letters of inquiry prove the necessity for additional investigations and experiments. The fact that 20 deer can be kept at the cost of keeping a single cow, and that waste land or land now yielding little or no profit may be used for the purpose, goes far to explain the interest aroused. Further investigation as to the practical possibilities of the business will be undertaken for the purpose of preparing a more complete report.

GEOGRAPHIC DISTRIBUTION.

It is hoped to complete the life-zone work in several of the States where extensive gaps in our information still exist, as in California, Oregon, Washington, Idaho, Montana, Wyoming, the Dakotas, and Utah, in order to permit the publication of a life-zone map of the United States on a much larger scale than the one last issued, which is inadequate for detailed information. And it is planned to continue the more detailed surveys of the Pacific Coast region, the results to be embodied in a special map of each State.

GAME PROTECTION.

INSPECTION.

Efforts will be made to place the inspection service at Philadelphia on a more satisfactory basis. Most of the consignments to Philadelphia arrive by way of New York and have heretofore been inspected at either port. In future, so far as possible, inspections will be made at Philadelphia, in order to avoid delays en route and the difficulty of identifying birds, which can not be readily examined on shipboard or on the dock. However, importers will have the option of having their birds inspected at either port.

RECORDING DATA.

The consolidated card index of species imported since the Lacey Act became effective, May 25, 1900, will be continued. The work of ascertaining the dates of the first importations of different species into this country will continue, with special attention to the collection of data respecting the history of the early importations of the more important game birds.

PHEASANTS.

The material relating to imported pheasants collected by the Department will be prepared for publication in the form of a Farmers'

Bulletin on Pheasant Breeding in the United States. For the purpose of securing additional matter the more important pheasantries and private preserves will be examined.

PRESERVES.

Bird Reservations.—The bird reservations already established by executive order, or which have been examined with a view to recommendation for establishment, number 20 or more. Of these, 6 are in Florida, 4 in Louisiana, 2 in Michigan, 2 in North Dakota, 3 in Oregon, and 3 in Washington. The protection of the smaller reservations has been provided for in cooperation with the National Association of Audubon Societies, which has defrayed most of the actual cost of maintenance. Provision must be made for the proper maintenance of the larger reservations, however, and it is only proper that the expense of all these Federal establishments should be borne by the Government.

Bison Range.—Provision is made in the current appropriation bill for the acquisition and fencing of 12,800 acres of land on the Flathead Reservation, Mont., for a National Bison Range. This land will probably be ready by the close of the fiscal year, and it is possible that the herd offered by the American Bison Society can be delivered soon after that date. Maintenance of this herd for the year ending June 30, 1910, must therefore be provided for. Estimates for this item and for the proper maintenance of the bird reservations have been included in the regular estimates of the Bureau.

INFORMATION CONCERNING GAME.

The plan outlined several years ago of indexing the earlier statutes relating to game protection has been steadily continued and will be pressed as rapidly as possible. It has now progressed far enough to allow the publication of complete indexes of the laws of Michigan, Alabama, and probably California, during the coming year. It is probable that indexes of the laws of all the Rocky Mountain States also will be completed during the year; work on these will have preference on account of the important bearing the laws of these States have on the protection of big game. Unforeseen circumstances have delayed the completion of the index to game decisions, but the work has been brought down to date and will probably be completed during the year.

STATISTICS OF GAME ANIMALS.

It is necessary to effective work to have more exact figures concerning certain features of game protection. Statistics of the number of hunters in the United States and the amounts derived from fees for hunting licenses have been secured with some degree of completeness. It is hoped that during the year some plan can be adopted in cooperation with the several States to ascertain the quantity of big game killed each season, particularly the number of deer and elk, so as to secure a basis for an approximate estimate of the value of the big game of the country.

BIG GAME.

Last year special efforts were made to protect the elk by suppressing tusk and trophy hunting and poaching south of the Yellowstone

National Park. During the coming year the question of adequately protecting antelope will have first consideration. Efforts will be made to secure close seasons in every State in which antelope occur and to obtain similar protection in Canada. An attempt will be made also to ascertain the location of every large band of antelope now remaining in the United States and the approximate number of individuals in each band.

INTERSTATE COMMERCE IN GAME.

The personal examination of conditions governing illegal shipments of game in the Southwest, unavoidably deferred last year, will be made in the autumn of 1908. Information obtained in connection with the prosecution of the Binkley-Purdy case, already referred to, emphasizes the importance of collecting more complete data respecting the traffic in hides, horns, and tusks of big game as a prerequisite to successful conduct of similar cases in the future. One or two of the Western States and Canadian Provinces have adopted a system of marking heads or horns for shipment or sale, and the methods in use will be examined with a view to devising, if feasible, a simple and practicable means of so marking horns as to prevent the disposal of trophies obtained contrary to law.

In previous reports attention has been called to the necessity for the creation of several districts, each under a special agent or supervisor, charged with the duty of enforcing the provisions of the Lacey Act relating to interstate shipments of game. The importance of having an agent on the ground in close touch with local conditions is apparent, and it is strongly urged that the necessary funds be placed at the disposal of this Bureau. If only one such officer can be provided he should be stationed in the West, with headquarters at Chicago, where he can readily investigate shipments from the Lake region, the Northwest, and many points in the Southwest. The cost of this service, including salary and traveling expenses, would be inconsiderable, while the gain in effectiveness of enforcement of the Federal law would be great.

REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ACCOUNTS AND DISBURSEMENTS,
Washington, D. C., October 20, 1908.

SIR: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1908.

Very respectfully,
A. ZAPPONE,
Chief of Division.

Hon. JAMES WILSON,
Secretary of Agriculture.

CHARACTER OF WORK.

The Division of Accounts and Disbursements audits, adjusts, and pays all accounts and claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements and schedules for annual supplies, and letters of authority; writes, for the signature of the Secretary, all letters to the Treasury Department pertaining to fiscal matters; examines and signs requisitions for the purchase of supplies; issues bills of lading and requests for passenger and freight transportation; prepares the annual estimates of appropriations; prepares annual reports to Congress, and transacts all other business relating to the financial interests of the Department.

On June 30, 1908, for the purpose of systematizing its work, the Division was divided into six sections, as follows:

CASHIER'S SECTION.

This section prepares and mails all checks and handles all moneys received and disbursed.

BOOKKEEPER'S SECTION.

This section keeps all books pertaining to the fiscal affairs of the Department, indexes all accounts, prepares all requisitions on the Treasury for advances of public funds, and has charge of the correspondence with the accounting officers of the Treasury in the settlement of accounts.

MISCELLANEOUS SECTION.

This section has charge of the preparation of the several annual reports to Congress and the audit and administrative examination of the accounts and disbursements of the Forest Service.

AUDITING SECTION A.

This section audits all salary and reimbursement accounts.

AUDITING SECTION B.

This section audits all purchase, telegraph, and express accounts; also all accounts of the Board of Consulting Scientific Experts.

FREIGHT AND TRANSPORTATION SECTION.

This section audits all freight accounts and prepares and issues all bills of lading and passenger and freight transportation requests.

APPROPRIATIONS, EXPENDITURES, ETC.

The total appropriations for the Department for the year ended June 30, 1908, amounted to $13,201,419.09, not including $720,000 and $432,000 appropriated for the several State agricultural experiment stations. Of this sum ($13,201,419.09), $11,212,809.95 was disbursed prior to the close of the year, leaving a balance of $1,988,609.14, nearly all of which is covered by outstanding liabilities. Supplemental accounts for the year 1907 were also paid, amounting to $860,926.91. The unexpended balances for the year 1906, amounting to $196,179.98, were finally covered into the Treasury on June 30, 1908.

There were received, audited, and paid 55,000 accounts, as follows: Weather Bureau, 11,500, amounting to $1,120,366.13; Bureau of Animal Industry, 12,620, amounting to $3,428,804.19; all other bureaus and divisions, 30,880, amounting to $8,652,248.77, a total of $13,201,419.09. In payment of these accounts 89,967 checks were drawn on the Treasury at Washington and the subtreasuries at New York and at Chicago.

There were also audited and sent to the Treasury Department for payment 1,128 accounts, including 393 for the Weather Bureau.

LOST CHECKS.

During the year 44 checks were lost in transit through the mails or by the payees.

REQUISITIONS, LETTERS, AND REQUESTS.

One hundred and ten requisitions were drawn on the Treasury, aggregating $8,551,638.32 (this does not include Forest Service).

The number of requisitions issued for supplies was 18,184.

The number of letters of authorization for travel was 4,102.

The number of letters written and received in the ordinary transaction of business was about 74,200.

The number of requests for passenger transportation was 22,993.

The number of requests on the Quartermaster-General for the transportation of Government property was 1,955.

The number of departmental bills of lading issued from March 1, 1908, to June 30, 1908, was 406.

The amount expended for telegraphing and telephoning by the Weather Bureau, including the West Indian cable service, was $230,374.04.

NEW BUILDINGS FOR DEPARTMENT.

Up to the present time Congress has appropriated for the purpose $1,500,000, of which sum there has been expended $1,469,705.67, leaving a balance on June 30, 1908, of $30,294.33.

TEMPORARY SPECIAL DISBURSING AGENTS.

There were 59 temporary special disbursing agents appointed during the year, and the sum of $187,205 from the appropriations of the Department was advanced, requiring the issuance of 142 requisitions upon the Treasury. This includes 45 appointed for Forest Service, amounting to $91,405, requiring 83 requisitions upon the Treasury. All accounts of temporary special disbursing agents of this Department are given an administrative examination in this Division before being forwarded to the Treasury Department for final audit and settlement.

MILEAGE BOOKS.

During the fiscal year there were purchased 363 mileage books for official use by employees of this department, at a cost of $17,161.15. The rebates on these books, amounting to $1,431.20, were deposited in the Treasury to the credit of the appropriations.

COMBINED ACCOUNTS.

For the purpose of reducing the large number of small accounts submitted to the Department by railroads, telegraph and telephone companies, contractors, and others, a circular letter was issued during the year requesting that all accounts due a single claimant be submitted in one voucher regardless of the number of bureaus and appropriations that might be involved, a special form being supplied for the purpose. The system has not only worked to the entire satisfaction of those doing business with the Department, but has also greatly reduced the clerical labor involved in such settlements. By way of illustration, the Chesapeake and Potomac Telephone Company of this city, prior to the adoption of the combined accounts system, rendered about twenty different accounts quarterly, one for each Bureau and Division of the Department; under the new system these are all combined in one voucher and presented as one account. More than 3,500 combined accounts were handled during the fiscal year 1908, and it is estimated that the preparation of at least 17,500 checks was thereby avoided, to say nothing of the saving in clerical labor.

PASSENGER TRANSPORTATION REQUESTS AND BILLS OF LADING.

During the year a new form of passenger transportation request was prepared by this Division and approved by the Comptroller of the Treasury. The new form is much smaller than the old and may be conveniently carried in the pocket of the traveler. A new bill of lading was also adopted and printed for general use of this Department in making freight and express shipments. The use of this bill of lading has facilitated the shipment of Government property and has found great favor with the railroad and other transportation companies.

APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE FISCAL YEAR 1908.

The table following shows for the fiscal year the amounts appropriated, disbursed, and unexpended:

Appropriations, disbursements, and unexpended balances for the fiscal year 1908.

Object.		Total amount appropriated.	Amount disbursed.	Balance of appropriation on hand.
Salaries, Department of Agriculture, officers and clerks	$825,890	$833,490.00	$771,881.43	$54,008.57
Salaries, extra labor	7,600		7,184.94	415.06
Contingent expenses		47,000.00	39,860.67	7,139.33
Library		12,500.00	10,745.32	1,754.68
Bureau of Animal Industry:				
General expenses	$892,200	947,200.00	774,562.84	117,637.16
Diseases of domestic animals, Minnesota	5,000		2,766.65	2,233.35
Animal breeding and feeding	50,000		46,840.81	3,159.19
Meat inspection (permanent appropriation)		3,000,000.00	2,481,539.40	518,460.60
Eradicating cattle ticks:				
1908		125,000.00	112,282.59	12,717.41
1907 and 1908 (appropriated $25,000, balance July 1, 1907)		10,811.90	10,811.90	Exhausted.
Bureau of Plant Industry:				
General expenses	$573,480	584,780.00	500,282.55	73,197.45
Rent and repairs	11,300		8,830.75	2,469.25
Grain investigations		40,000.00	33,106.15	6,893.85
Purchase and distribution of valuable seeds (includes $50,000, deficiency act)	$252,000	288,000.00	235,648.84	16,351.16
Foreign seed and plant introduction	36,000		26,006.49	9,993.51
Cotton boll weevil investigations:				
1908		110,000.00	95,607.35	14,392.65
1907 and 1908 (appropriated $40,000, balance July 1, 1907)		35,632.42	32,458.62	3,173.80
Bureau of Chemistry:				
Laboratory		650,000.00	467,654.99	182,345.01
Bureau of Soils:				
Soil investigations	$166,000	170,000.00	146,905.64	19,094.36
Rent of buildings	4,000		3,156.66	843.34
Bureau of Entomology:				
Entomological investigations	$103,800	113,800.00	90,923.05	12,876.95
White fly investigations	10,000		8,576.50	1,423.50
Cotton boll weevil investigations		40,000.00	34,592.99	5,407.01
Preventing spread of moths, 1907 and 1908 (appropriated $150,000, balance July 1, 1907)		141,407.27	122,857.32	18,549.95
Bureau of Biological Survey:				
Biological investigations		44,420.00	39,629.92	4,790.08
Division of Publications:				
Publications[a]		35,000.00	32,889.67	2,110.33
Bureau of Statistics:				
Collecting agricultural statistics	$118,000	122,900.00	96,344.56	21,655.44
Foreign markets investigations	4,900		4,338.62	561.38
Office of Experiment Stations:				
Agricultural experiment stations ($827,000)[b]	$30,000	107,000.00	26,471.55	3,528.45
Farmers' institutes	5,000		4,348.68	651.32
Station at Alaska	24,000		24,000.00	Exhausted.
Station at Hawaii	24,000		24,000.00	Exhausted.
Station at Porto Rico	24,000		24,000.00	Exhausted.

[a] Congress also appropriated in the sundry civil bill for printing and binding, $433,750.

[b] This includes $720,000 for State experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $432,000 as a permanent appropriation for State experiment stations under the Adams bill, to be paid through the Treasury Department. Total to be paid through the Treasury Department for State experiment stations, $1,152,000.

Appropriations, disbursements, and unexpended balances for the fiscal year 1908—Cont'd.

Object.	Total amount appropriated.	Amount disbursed.	Balance of appropriation on hand.
Office of Experiment Stations—Continued.			
Nutrition investigations	$5,000.00	$1,593.00	$3,407.00
Irrigation investigations	150,000.00	115,164.28	34,835.72
Office of Public Roads:			
Public road inquiries $55,660	57,660.00	48,930.52	6,729.48
Rent and repairs 2,000		1,723.27	276.73
Total	7,671,601.59	6,508,518.52	1,163,083.07
WEATHER BUREAU.			
Salaries	196,990.00	187,983.40	9,006.60
Fuel, lights, and repairs	10,000.00	7,143.66	2,856.34
Contingent expenses	10,000.00	8,032.53	1,967.47
Salaries, station employees	551,550.00	505,765.11	45,784.89
General expenses	645,000.00	411,441.43	233,558.57
Total	1,413,540.00	1,120,366.13	293,173.87
FOREST SERVICE.			
Salaries, officers and clerks	143,200.00	130,031.93	13,168.07
General expenses $1,696,800	1,756,800.00	1,519,591.85	177,208.15
Rent (joint resolution, Jan. 7, 1908, increasing rent) 60,000		43,010.88	16,989.12
Administration, etc., of National Forests, 1908	375,000.00	291,353.63	83,646.37
Survey and report on Appalachian and White Mountain watersheds, 1907 and 1908 (appropriated $25,000, balance July 1, 1907)	23,403.76	15,272.33	8,131.43
Administration, etc., of the National Forests, 1907 and 1908 (appropriated $125,000, balance July 1, 1907)	118,786.79	109,149.79	9,637.00
Total	2,417,190.55	2,108,410.41	308,780.14
Total of all regular appropriations for entire Department	11,502,332.14	9,737,295.06	1,765,037.08
SPECIAL APPROPRIATIONS.			
Pomological investigations, fund from sale of fruits and vegetables, balance July 1, 1907	1,779.40	1,011.28	768.12
Agricultural experiment stations, fund from sale of card indexes, balance July 1, 1907	65.15	65.15	Exhausted.
Administration, etc., forest reserves ($2,401,328.97), balance July 1, 1907	1,172,922.36	988,318.93	184,603.43
Cooperative work, forest investigations	28,979.97	21,073.79	7,906.18
Buildings, Department of Agriculture ($1,250,000):			
Balance available on July 1, 1907 $245,340.07	495,340.07	465,045.74	30,294.33
Sundry civil act, March 4, 1907 250,000.00			
Grand total of all appropriations available for Department for fiscal year 1908	13,201,419.09	11,212,809.95	1,988,609.14

MONTHLY CHECK STATEMENTS.

The check statements submitted by the Treasury and subtreasuries were compared with the checks issued by this Division, and the amounts verified.

ANNUAL SUPPLIES.

Annual supplies for the use of the various branches of the Department were freely advertised for in the usual manner and at a uniform time with the other Executive Departments, and contracts were made covering as nearly as practicable all the lines of supplies needed during the year. The method pursued by this Department in advertising for supplies and in obtaining competition thereon is thought to accomplish very fully the object sought. Advertising is done not only through the medium of daily newspapers in the large cities for a certain period before the supplies are needed, but hundreds of copies of the advertisement in the form of printed slips are mailed to known dealers in the wares required. All bids are submitted to and are passed upon by a board of award acting under the instructions and by the authority of the Secretary. Supplies aggregating an amount less than $50 may, under the act of March 1, 1899, be purchased in the open market.

PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from various sources and deposited in the Treasury to the credit of the proper funds the following sums:

Miscellaneous receipts, sales of condemned property, etc	$10, 717. 54
Sales of card index	54. 31
Telegraph-line receipts, Weather Bureau	3, 275. 74
Sales of products, agricultural station, Hawaii	228. 12
Sales of products, agricultural station, Porto Rico	2, 534. 48
Sales of products, agricultural station, Alaska	1, 321. 94
Total	18, 132. 13

In this connection it is thought desirable to explain the method pursued in receiving and disposing of the moneys pertaining to the several funds.

The proceeds of "condemned property" and "library index cards" are covered into the Treasury to the credit of "Miscellaneous receipts," under section 3618 of the Revised Statutes.

The moneys received from the sale of "card index of agricultural literature" prepared by the Office of Experiment Stations is covered into the Treasury to the credit of that appropriation, as provided by the appropriation act.

Moneys derived from the sales of products at the insular stations in Hawaii, Porto Rico, and Alaska are used for the maintenance of those stations.

Up to June 30, 1907, the moneys derived from the sales of "publications" issued by the Weather Bureau were deposited in the Treasury to the credit of the appropriation "General expenses" of that Bureau, under section 227 of the Revised Statutes. Since July 1, 1907, these moneys have been deposited to "Miscellaneous receipts," in accordance with the provision in the act making appropriations for this Department for the fiscal year ending June 30, 1908. (34 Stat. L., p. 1258.)

"Seacoast telegraph line receipts" are covered into the Treasury under act of March 3, 1883. (22 Stat. L., 616.)

In acknowledgment of each deposit of funds the Treasurer issues to the depositor a duplicate certificate of deposit. The number of this certificate is entered as part of the transaction, and the certificate is filed in this Division.

These moneys are forwarded to the Division of Accounts and Disbursements from the various Bureaus, Divisions, and Offices of the Department, accompanied by a letter, or specially printed form, in duplicate, explaining from whence the money was derived. The duplicate is receipted by the Chief of this Division and returned to the sender. The original is placed in the files of this Division as a voucher. The amount received is entered in a book with a description of the transaction copied from the letter of transmittal. If in the form of cash or postal money order, it is so stated in the entry, and if by check or draft a minute description is given, with name of payor, payee, indorser, name of bank, number and date of check, etc. The law requires that money so received shall be deposited in the Treasury within thirty days after its receipt by a Government officer. The practice in this office is to deposit all sums as soon as practicable after they are received, unless of an insignificant amount. The Chief of this Division, having no authority to do otherwise, accepts the statements accompanying sums of money submitted to him, assuming them to be in strict accordance with the facts.

ACCOUNTS FOR THE FISCAL YEAR 1906 FINALLY CLOSED.

As required by section 5, legislative act, approved June 20, 1874 (18 Stat. L., 110-111), the unexpended balances of the appropriations for the year 1906 were finally covered into the Treasury on June 30, 1908, and carried to the surplus fund, as follows:

Amount of unexpended balances for fiscal year 1906 turned into the Treasury.

Object.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Salaries, Department of Agriculture, officers and clerks	$804,970	$783,042.64	$21,927.36
Salaries, extra labor	10,000	9,120.34	879.66
Bureau of Animal Industry:			
General expenses, including $63,000 deficiency	1,492,020	1,405,951.28	86,068.72
Animal breeding and feeding	25,000	24,429.56	570.44
Rent of buildings	2,500	1,802.00	698.00
Bureau of Plant Industry:			
Vegetable pathological investigations	139,640	135,320.51	4,319.49
Rent of building	6,000	3,720.00	2,280.00
Vegetable pathological investigations, 1905-6	10,000	9,560.46	439.54
Grain investigations	25,000	23,843.68	1,156.32
Pomological investigations	33,640	33,639.62	.38
Rent of building	2,000	2,000.00	....
Botanical investigations and experiments	60,840	59,338.60	1,501.40
Rent of building	3,000	3,000.00	....
Grass and forage plant investigations	37,160	33,279.00	3,881.00
Rent of building	2,500	2,490.00	10.00
Experimental gardens and grounds	15,320	15,273.75	46.25
Experimental gardens and grounds, 1905-6	5,000	4,978.00	22.00
Arlington Experimental Farm	20,000	19,667.35	332.65
Tea culture investigations	8,500	7,944.83	555.17
Purchase and distribution of valuable seeds	205,140	202,767.39	2,372.61
Foreign seed and plant introduction	37,780	32,429.83	5,350.17
Investigating production of domestic sugar	7,500	7,317.54	182.46
Forest Service:			
General expenses	768,180	767,722.04	457.96
Rent of buildings	25,000	25,000.00	....
Bureau of Chemistry:			
Laboratory, including $3,000 for table sirup	130,920	128,289.99	2,630.01
Bureau of Soils:			
Soil investigations, including $4,000 for rent of building	170,000	167,403.73	2,596.27
Bureau of Entomology:			
Entomological investigations, including $2,500 for moth investigations	68,060	65,457.52	2,602.48
Bureau of Biological Survey:			
Biological investigations	44,420	44,064.71	355.29
Publications, Department of Agriculture, Farmers' Bulletins	98,750	98,601.49	148.51
Artists, etc	3,500	3,434.10	65.90
Labor, etc	30,000	29,767.04	232.96
Bureau of Statistics:			
Collecting agricultural statistics $93,900	98,800	90,007.12	3,892.88
Foreign market investigations 4,900		4,720.13	179.87
Library, Department of Agriculture	8,040	7,411.73	628.27
Contingent expenses, Department of Agriculture	35,000	34,878.55	121.45
Contingent expenses, 1905-6	2,000	2,000.00	....
Agricultural experiment stations ($794,660)[a]	21,660	20,908.90	751.10
Station of Alaska including $3,000 for purchase of live stock	18,000	18,000.00	....
Station of Hawaii	15,000	15,000.00	....
Station of Porto Rico	15,000	15,000.00	....
Farmers' institutes	5,000	4,550.52	449.48
Nutrition investigations	20,000	19,805.11	194.89
Irrigation investigations	74,200	74,044.61	155.39
Public road inquiries	37,660	36,479.77	1,180.23
Cotton boll weevil investigations	190,000	154,671.59	35,328.41
Total	4,832,700	4,648,135.03	184,564.97

[a] This includes $720,000 for State experiment stations paid through the Treasury Department.

Amount of unexpended balances for fiscal year 1906 turned into the Treasury—Cont'd.

Object.	Amount appropriated.	Amount disbursed.	Amount unexpended.
WEATHER BUREAU.			
Salaries	$191,430	$190,930.72	$499.28
Fuel, lights, and repairs	10,000	9,926.33	73.67
Contingent expenses	10,000	9,841.53	158.47
Salaries, station employees	531,550	530,662.89	887.11
General expenses	562,010	553,143.78	8,866.22
Buildings	53,000	52,748.43	251.57
Cables and land lines	35,000	34,121.31	878.69
Total	1,392,990	1,381,374.99	11,615.01
Grand total	6,225,690	6,029,510.02	196,179.98

NOTE.—Expenses, Bureau of Animal Industry, 1905 and prior years, $375. Protection of forest reserves, 1905 and prior years, $60. Forestry investigations, certified claims, $4.12 (claim paid, see repay warrant No. 3493, March, 1908).

BUILDINGS RENTED IN THE DISTRICT OF COLUMBIA.

The following statement shows the buildings under rent in the District of Columbia on June 30, 1908:

Buildings rented in the District of Columbia.

Location of buildings.	For what purpose used.	Annual rental.
No. 1362 B street SW	Bureau of Animal Industry, laboratories and offices	$1,800
No. 1358 B street SW	Bureau of Animal Industry, offices	750
Munsey Building	do	6,520
No. 902 Pennsylvania avenue NW	do	240
No. 1228 C street SW	Bureau of Animal Industry, stable	144
Nos. 1304–1306 B street SW	Bureau of Plant Industry, offices	3,000
No. 1308 B street SW	do	360
No. 201 Thirteenth street SW	do	360
No. 224 Twelfth street SW	do	3,000
No. 203 Thirteenth street SW	do	420
No. 205 Thirteenth street SW	do	420
No. 207 Thirteenth street SW	do	420
No. 207½ Thirteenth street SW	do	420
No. 209 Thirteenth street SW	do	420
No. 237 Fourteenth street SW	do	120
No. 1310 B street SW	do	180
No. 1224 B street SW	do	450
No. 1226 B street SW	do	450
No. 1316 B street SW	do	1,500
No. 221 Linwood place SW	Bureau of Plant Industry (seed building)	3,000
Atlantic Building, 930 F street NW	Forest Service, offices	22,043
Ouray Building, Eighth and G streets NW.	do	1,428
No. 1520 Pennsylvania avenue SE	Forest Service, wood-testing laboratories	600
Rear of 913 E street NW	Forest Service, storage purposes	270
Rear of 922 and 924 F street NW	do	270
No. 928 Baptist alley NW	do	120
Nos. 202–204 Fourteenth street SW	Bureau of Chemistry, laboratories and offices	2,500
No. 206 Fourteenth street SW	Bureau of Chemistry, storage rooms	300
No. 207 Linwood place SW	Bureau of Chemistry, office and storage rooms	300
No. 300 Fourteenth street SW. (two apartments).	Bureau of Chemistry, offices	600
No. 300 Fourteenth street SW. (one apartment).	do	300
Nos. 208–210 Fourteenth street SW	Bureau of Soils, laboratories and offices	2,600
Nos. 212–214 Thirteenth street SW	do	1,320
No. 904 B street SW	Bureau of Entomology, offices	720
No. 215 Thirteenth street SW	Division of Publications, document rooms	5,000
No. 916 Pennsylvania avenue NW	Division of Publications, storage rooms	60
No. 237 Fourteenth street SW	Office of Public Roads, offices	1,880
Lot 27, square 231, SW	Office of Public Roads, stable	120
No. 1120 Virginia avenue SW	Office of Experiment Stations, offices	1,000
No. 611 Maryland avenue SW	Office of chief clerk, storage rooms	300
Total		65,705

ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1909, were prepared in this Division, based upon recommendations made by the Chiefs of the several Bureaus and Divisions, and after receiving the approval of the Secretary were forwarded to the Treasury in accordance with statutory requirements.

APPROPRIATIONS AND ESTIMATES FOR 1909.

Estimates for 1909.

Salaries, office of Secretary	$126,620	
Emergency roll	7,600	
		$134,220
Weather Bureau:		
Salaries, office of chief of Bureau		202,510
Fuel, lights, and repairs		10,000
Contingent expenses		12,000
Salaries, station employees		617,050
General expenses		687,500
Bureau of Animal Industry:		
Salaries		84,210
General expenses	947,200	
Animal breeding and feeding	50,000	
		997,200
Eradicating cattle ticks		150,000
Bureau of Plant Industry:		
Salaries		187,410
General expenses		666,266
Grain investigations		65.000
Purchase and distribution of valuable seeds	208,000	
Foreign seeds	41,000	
		249,000
Cotton boll weevil investigations		150,000
Forest Service:		
Salaries		144,300
General expenses	3,001,900	
Rent	50,000	
		3,051,900
Bureau of Chemistry:		
Salaries		66,720
Laboratory		750,000
Bureau of Soils:		
Salaries		40,600
Soil investigations		200,000
Bureau of Entomology:		
Salaries		26,360
Entomological investigations		149,240
Cotton boll weevil investigations		50,000
Preventing spread of moths		150,000
Bureau of biological survey:		
Salaries		9,780
Biological investigations		60,170
Division of Accounts and Disbursements:		
Salaries		46,490
Division of Publications:		
Salaries		141,830
Publications, Department of Agriculture		40,000
Bureau of Statistics:		
Salaries		96,440
Collecting agricultural statistics	138,000	
Foreign market investigations	4,900	
		142,900

Library:		
Salaries		$18,080
General expenses		17,500
Miscellaneous:		
Contingent expenses		78,200
Paper making		10,000
Office of Experiment Stations:		
Salaries		34,620
Agricultural experiment stations, to be disbursed by the Treasury Department		720,000
General expenses	$33,995	
Farmers' institutes	10,000	
Station at Alaska	26,000	
Station at Hawaii	26,000	
Station at Porto Rico	26,000	
Station at Guam	5,000	
		126,995
Nutrition investigations		25,000
Irrigation investigations		150,000
Office of Public Roads:		
Salaries		15,240
Public road inquiries	89,620	
Rent	2,000	
		91,620
Total of agricultural bill, which includes $720,000 for agricultural experiment stations, to be disbursed by Treasury Department		10,666,351
Estimates, permanent appropriations:		
Meat inspection, Bureau of Animal Industry		3,000,000
Estimates in sundry civil bill:		
Printing and binding		550,000
Grand total of all estimates for the Department of Agriculture		14,216,351

Appropriated for 1909.

Salaries, officers and clerks	$879,660	
Salaries, extra labor	7,600	
		$887,260.00
Contingent expenses		86,200.00
Library		15,500.00
Bureau of Animal Industry:		
General expenses	947,200	
Animal breeding and feeding	50,000	
		997,200.00
Meat inspection (permanent appropriation)		3,000,000.00
Eradicating cattle ticks, 1909		225,000.00
Eradicating cattle ticks, 1908 and 1909		25,000.00
Bureau of Plant Industry:		
General expenses, 1909		886,266.00
General expenses, 1908 and 1909		10,000.00
Purchase and distribution of valuable seeds	202,000	
Foreign seed and plant introduction	56,000	
		258,000.00
Paper tests		10,000.00
Bureau of Chemistry: Laboratory		760,000.00
Bureau of Soils: Soil investigations		200,000.00
Bureau of Entomology:		
Entomological investigations, 1909		148,800.00
Entomological investigations, 1908 and 1909		10,000.00
Preventing spread of moths, 1908 and 1909		250,000.00
Bureau of Biological Survey: Biological investigations		54,420.00
Division of Publications: Publications[a]		40,000.00
Bureau of Statistics: Collecting agricultural statistics		125,000.00

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[a] Congress also appropriated in the sundry civil bill for printing and binding, $460,000.

Office of experiment stations:		
Agricultural experiment stations ($843,000)[a]	$30,000	
Farmers' institutes	10,000	
Station at Alaska	26,000	
Station at Hawaii	26,000	
Station at Porto Rico	26,000	
Station at island of Guam	5,000	
		$123,000.00
Nutrition investigations		7,000.00
Irrigation investigations		150,000.00
Office of Public Roads:		
Public road inquiries	73,000	
Rent and repairs	2,000	
		75,000.00
Total for main Department, exclusive of Weather Bureau and Forest Service		8,343,646.00

WEATHER BUREAU.

Salaries	202,510.00
Fuel, lights, and repairs	10,000.00
Contingent expenses	11,000.00
Salaries, station employees	586,750.00
General expenses	852,000.00
Total for Weather Bureau	1,662,260.00

FOREST SERVICE.

Salaries, officers and clerks	144,300.00
General expenses	3,151,900.00
Improvement of the National Forests	600,000.00
Naval stores industry	10,000.00
National bison range	40,000.00
Total for Forest Service	3,946,200.00
Total of all regular appropriations for entire Department	13,952,106.00

SPECIAL APPROPRIATIONS.

Pomological investigations, fund from sale of fruits and vegetables, balance July 1, 1908	768.12
Buildings, Department of Agriculture ($1,250,000): Balance available on July 1, 1908	30,294.33
Cooperative work, forest investigations	
Grand total of all appropriations available for the Department for the fiscal year 1909	13,983,168.45

FISCAL AFFAIRS OF THE FOREST SERVICE.

For the purpose of having a record of all the fiscal affairs of the Department in one report, so that it may be of easy reference to the Secretary and others interested therein, the following statement, furnished by the fiscal agent of the Forest Service, is printed:

Statement of the fiscal transactions of the Forest Service.

Number of requisitions issued for supplies	4,341
Number of letters of authorization issued for travel	2,780
Number of accounts paid during the fiscal year 1908, including those paid from the cooperative fund	25,386

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[a] This includes $720,000 for State experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $528,000 as a permanent appropriation for State experiment stations under the Adams bill to be paid through the Treasury Department. Total to be paid through the Treasury Department for State experiment stations, $1,248,000.

Total amount of accounts paid from the appropriations for 1908, including the cooperative fund	$3,166,481.74
Total amount of supplemental accounts paid from the appropriations for the fiscal year 1907; that is, July 1 to September 30, 1907	$286,956.38
Number of accounts paid, and the total amount thereof, for the fiscal year 1907, from October 1, 1907, to June 30, 1908, under waiver from the Treasury Department	$49,844.53
Number of checks drawn during the fiscal year above named in payment of accounts for 1908, and supplemental accounts of 1907	41,234
Number of transportation requests issued	37,000
Number of requisitions on the Quartermaster's Department for freight transportation (Forest Service bill of lading used since April 17, 1908)	608
Amount of money received from sale of condemned property	$788.39
Amount of money collected on account of loss of Government property	$259.86
Number of accounts forwarded to the Treasury Department for direct settlement	305
Number of checks lost in transit through the mails, or by payees	55
Number of letters written and received in the ordinary transaction of business (about)	63,652
Amount of money received from timber sales, etc	$1,842,281.87
Amount of money for cooperative work (including $2,351.47 brought forward from previous fiscal year)	$28,979.97
Number of requisitions drawn on the Treasury for advances of money.	150
Temporary special disbursing agents appointed	45
Requisitions drawn on the Treasury Department for advances of public funds to temporary special disbursing agents, amounting to $91,405.	83

ANNUAL REPORT OF EXPENDITURES.

A classified statement of the expenditures of the Department for the fiscal year ended June 30, 1908, was prepared in accordance with law and submitted to the Committee on Expenditures. A recapitulation of the expenditures of the Department will be found below, classified as required by the committee:

Recapitulation of the several appropriations for the entire Department of Agriculture as distributed among the following groups, and the total expenditures under each.

Statutory salaries	1,550,969.32
Lump fund salaries in Washington	1,450,550.47
Lump fund salaries outside of Washington	5,989,131.21
Stationery	150,702.02
Miscellaneous supplies and services, equipment, books, machinery, etc	1,797,971.95
Furniture	93,810.87
Fuel	31,108.04
Freight	23,889.90
Express	15,232.57
Telegraph	194,178.55
Telephone	28,630.37
Rent	195,892.58
Gas and electricity	20,846.67
Apparatus, instruments, and laboratory material	181,374.97
Printing and binding	5,410.01
Travel and station and field expenses	978,811.03
Total	12,308,510.53

Total appropriations for Department of Agriculture		13,341,639.84
Total expenditures under above groups	$12,308,510.53	
Advances to temporary special disbursing agents	157,878.77	
Forest Service refunds	217,228.91	
Total expenditures of entire Department of Agriculture		12,683,618.21
Balance		658,021.63

Of this amount the balance on June 30, 1908, under the several appropriations which were available until used, was	$31,062.45
Unexpended balance September 30, 1908	626,959.18
Repayments to credit of appropriations through Treasury	7,987.79
Net unexpended balance on September 30, 1908	634,946.97
Outstanding liabilities (estimated)	243,196.27
Balance to be turned back into Treasury (estimated)	391,750.70

CONDITION OF WORK IN THE DIVISION.

The work of the Division is up to date, but to keep it so it has been necessary to have several clerks detailed from the Secretary's office to assist the regular force of the Division. In the estimates for next year several additional clerks will be asked for to meet the additional demands imposed on this Division by the large increase in the appropriations, the preparation of several reports for Congress, and for making the administrative examinations of the accounts and disbursements of the Forest Service.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture from the fiscal year 1839 to the fiscal year 1907, inclusive.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collection of agricultural statistics, etc	Mar. 3, 1839	5	354	9	1839	$1,000.00	$1,000.00	....
	Aug. 26, 1842	5	533	26	1842	1,000.00	1,000.00	....
	Mar. 3, 1843	5	642	1	1844	2,000.00	2,000.00	....
	June 17, 1844	5	687	1	1845	2,000.00	2,000.00	....
	Mar. 3, 1845	5	757	1	1846	3,000.00	3,000.00	....
	Mar. 3, 1847	9	160	1	1847	3,000.00	3,000.00	....
	Aug. 12, 1848	9	285	1	1848	3,500.00	3,500.00	....
Chemical analyses of vegetable substances	do	9	285	1	1848	1,000.00	1,000.00	....
Collection of agricultural statistics, etc	Mar. 3, 1849	9	364	1	1849	3,500.00	3,500.00	....
Chemical analyses of vegetable substances	do	9	364	1	1850	1,000.00	1,000.00	....
Collection of agricultural statistics	Sept. 30, 1850	9	541	1	1850	4,500.00	4,500.00	....
	Mar. 3, 1851	9	615	1	1851	5,500.00	5,500.00	....
Collection of agricultural statistics and purchase of seeds	Aug. 31, 1852	10	95	1	1852	5,000.00	5,000.00	....
	Mar. 3, 1853	10	208	1	1853	5,000.00	5,000.00	....
Collection of agricultural statistics and purchase, etc., of seeds	May 31, 1854	10	292	1	1854	10,000.00	10,000.00	....
	Aug. 4, 1854	10	567	1	1865	50,000.00	50,000.00	....
	Mar. 3, 1855	10	664	1				
Collection of agricultural statistics, etc., and purchase, etc., of seeds	May 15, 1856	11	14	1	1856	30,000.00	30,000.00	....
	Aug. 18, 1856	11	89	1	1857	75,000.00	75,000.00	....
	Mar. 3, 1857	11	226	1	1858	60,000.00	60,000.00	....
Information in relation to consumption of cotton	do	11	226	1	1858	3,500.00	3,157.25	$342.75
Collection of agricultural statistics, etc., and purchase, etc., of seeds	June 12, 1858	11	321	1	1859	60,000.00	60,000.00	....
	Mar. 3, 1859	11	427	1	1860	40,000.00	40,000.00	....
	June 25, 1860	12	108	1	1861	60,000.00	60,000.00	....
	Mar. 2, 1861	12	217	1	1862	64.000.00	63,704.21	295.79
	Feb. 13, 1862	12	338	...				
Collection of agricultural statistics, etc., and purchase, etc., of seeds, including a deficiency appropriation of $20,000, made March 3, 1863	Mar. 1, 1862	12	350	1	1863	80,000.00	80,000.00	....
Salaries	Feb. 25, 1863	12	691	1	1864	5,000.00	5,000.00	....
Collection of agricultural statistics, etc., and purchase, etc., of seeds	do	12	691	1	1864	87,000.00	87,000.00	....
Culture of cotton and tobacco	do	12	691	1	1864	3,000.00	3,000.00	....
Investigations with flax and hemp	do	12	691	1	1864	20,000.00	9,500.00	10,500.00
Purchase of sorghum seed	Mar. 14, 1864	13	23	1	1864	2,000.00	2,000.00	....
To rebuild shop in propagating garden	do	13	23	1	1864	800.00	800.00	....
Postage	do	13	23	1	1864	1,320.00	1,320.00	....
Furniture, carpets, fuel, etc	do	13	23	1	1864	650.00	650.00	....
Salaries	June 25, 1864	13	155	1	1865	38,300.00	38,300.00	....
	July 2, 1864	13	350	2				
Contingent expenses	June 25, 1864	13	155	1	1865	3,500.00	3,500.00	....
Collecting agricultural statistics	do	13	155	1	1865	20,000.00	20,000.00	....
Furniture, carpets, etc	do	13	155	1	1865	800.00	800.00	....
Library and laboratory	do	13	155	1	1865	4,000.00	4,000.00	....
Purchase and distribution of seeds	do	13	155	1	1865	61,000.00	61,000.00	....
Experimental garden and grounds	do	13	155	1	1865	15,800.00	15,800.00	....
To pay a debt incurred in preparing the Agricultural Report for 1861	July 2, 1864	13	350	2	1865	3,704.05	3,596.55	107.50
Rent, etc., of Commissioner's office	July 4, 1864	13	381	3	1865	3,500.00	3,500.00	....
Salaries	Mar. 2, 1865	13 13	160 455	3 1	1866	46,726.59	46,726.59	....
Contingent expenses	do	13	455	1	1866	7,500.00	7,500.00	....
Collecting agricultural statistics	do	13	455	1	1866	20,000.00	20,000.00	....
Purchase, etc., of seeds	do	13 13	160 455	3 1	1866	70,165.90	70,165.90	....
Experimental garden and grounds, etc	do	13 13	160 455	3 1	1866	23,395.33	23,395.33	....
Salaries	July 23, 1866	14	201	1	1867	39,600.00	39,600.00	....
Contingent expenses	do	14	201	1	1867	11,500.00	11,500.00	....

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collecting agricultural statistics	July 23, 1866	14	201	1	1867	$10,000.00	$10,000.00	....
Purchase of seeds	do Mar. 30, 1867	14 14 15	201 202 28	1 1 1	1867	115,200.00	115,200.00	....
Experimental garden and grounds, etc	July 23, 1866	14	202	1	1867	22,800.00	22,800.00	....
Salaries	Mar. 2, 1867	14	451	1	1868	38,020.00	38,020.00	....
Contingent expenses	do	14	451	1	1868	13,000.00	13,000.00	....
Collecting agricultural statistics	do	14	451	1	1868	10,000.00	8,406.34	$1,593.66
Purchase, etc., of seeds	do	14	452	1	1868	85,200.00	85,200.00	....
Museum	do	14	452	1	1868	10,000.00	10,000.00	....
Experimental garden and grounds	do	14	452	1	1868	22,800.00	22,800.00	....
To erect a building for the Department of Agriculture	do	14	464	1	1868	100,000.00	99,668.00	332.00
For certain goods and services furnished the Department	July 13, 1868	15	90	1	......	37,604.70	37,604.70	....
Salaries	July 20, 1868	15	105	1	1869	65,368.00	65,368.00	....
Collecting agricultural statistics	do	15	106	1	1869	10,000.00	10,000.00	....
Contingent expenses	do	15	196	1	1869	31,090.00	31,090.00	....
Experimental garden and grounds	do	15	106	1	1869	23,500.00	23,500.00	....
Purchase, etc., of seeds	do	15	106	1	1869	20,000.00	20,000.00	....
Furniture, cases, and repairs	do	15	106	1	1869	22,635.00	22,635.00	....
Salaries	Mar. 3, 1869	15 15	297 298	1 1	1870	69,240.00	67,720.00	1,520.00
Collecting agricultural statistics	do	15	298	1	1870	15,000.00	15,000.00	....
Investigations of cattle disease	do	15	298	1	1870	15,000.00	12,695.60	2,304.40
Contingent expenses	do	15	298	1	1870	13,200.00	13,200.00	....
Furniture, cases, and repairs	do	15	298	1	1870	2,500.00	2,500.00	....
Experimental garden and grounds	do	15	298	1	1870	21,500.00	21,500.00	....
Purchase, etc., of seeds	do	15	298	1	1870	20,000.00	18,981.33	1,018.67
Salaries	July 12, 1870 July 15, 1870	16 16	245 314	1 1	1871	71,980.00	71,811.64	168.36
Collecting agricultural statistics	July 12, 1870	16	245	1	1871	15,000.00	15,000.00	....
Purchase, etc., of seeds	do	16	246	1	1871	30,000.00	28,865.17	1,134.83
Experimental garden and grounds	do July 15, 1870	16 16 16	246 302 303	1 1 1	1871	53,200.00	53,200.00	....
Contingent expenses	July 12, 1870	16	246	1	1871	8,100,00	8,100.00	....
Furniture, cases, and repairs	do	16	246	1	1871	4,700.00	4,700.00	....
Collecting and modeling specimens of fruit	do	16	246	1	1871	1,000.00	1,000.00	....
Library	do	16	246	1	1871	1,000.00	1,000.00	....
Herbarium	do	16	246	1	1871	1,000.00	1,000.00	....
Laboratory	do	16	246	1	1871	1,700.00	1,700.00	....
Folding room	do	16	246	1	1871	500.00	500.00	....
Salaries	Mar. 3, 1871	16	489	1	1872	75,170.00	75,017.89	152.11
Collecting agricultural statistics	do	16	489	1	1872	15,000.00	14,059.36	940.64
Purchase and distribution of seeds, etc	do	16	489	1	1872	45,000.00	45,000.00	....
Experimental garden and grounds	do	16 16	489 509	1 1	1872	36,800.00	36,800.00	....
Contingent expenses	do	16 16	489 490	1 1	1872	12,900.00	12,900.00	....
Furniture, cases, and repairs	do	16	490	1	1872	4,700.00	4,700.00	....
Collecting and modeling specimens of fruit	do	16	490	1	1872	1,000.00	1,000.00	....
Herbarium	do	16	490	1	1872	1,000.00	1,000.00	....
Library	do	16	490	1	1872	2,050.00	2,050.00	....
Laboratory	do	16	490	1	1872	3,450.00	3,450.00	....
Salaries	May 8, 1872	17	77	1	1873	75,890.00	75,889.73	.27
Collecting agricultural statistics	do	17	77	1	1873	15,000.00	15,000.00	....
Purchase and distribution of seeds	do	17	77	1	1873	55,000.00	55,000.00	....

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Experimental garden and grounds	May 8, 1872 June 10, 1872	17 17	77 368	1 1	1873	$31,000.00	$31,000.00	....
Contingent expenses	May 8, 1872	17 17	77 78	1 1	1873	13,300.00	12,507.06	$792.94
Folding room	do	17	77	1	1873	300.00	300.00	....
Furniture, cases, and repairs	do	17	78	1	1873	5,200.00	5,200.00	....
Museum and herbarium	do June 10, 1872	17 17	78 369	1 1	1873	5,000.00	4,674.43	325.57
Library	May 8, 1872	17	78	...	1873	1,750.00	1,750.00	....
Salaries	Mar. 3, 1873	17	506	1	1874	78,190.00	76,924.00	1,266.00
Collecting agricultural statistics	do	17	506	1	1874	15,000.00	11,553.20	3,446.80
Purchase and distribution of seeds, etc	do	17 17 17	506 507 540	1 1 1	1874	65,000.00	64,904.89	95.11
Experimental garden and grounds	do	17 17	507 529	1 1	1874	26,200.00	25,731.74	468.26
Museum and herbarium	do	17	507	1	1874	2,000.00	1,942.02	57.98
Contingent expenses	do	17	507	1	1874	13,600.00	12,699.34	900.66
Furniture, cases, and repairs	do	17	507	1	1874	4,200.00	3,302.40	897.60
Library	do	17	507	1	1874	1,500.00	1,259.10	240.90
Postage	do	17	542	4	1874	52,000.00	35,449.09	16,550.91
Salaries	June 20, 1874	18	107	1	1875	77,180.00	77,127.60	52.40
Collecting agricultural statistics	do	18	107	1	1875	15,000.00	12,147.56	2,852.44
Purchase and distribution of seeds, etc	do Jan. 25, 1875	18 18	107 303	1 3	1875	95,000.00	94,719.83	280.17
Furniture, cases, and repairs	June 20, 1874	18	107	1	1875	4,200.00	4,135.36	64.64
Experimental garden and grounds	do June 23, 1874	18 18	107 227	1 1	1875	24,100.00	24,094.06	5.94
Contingent expenses	June 20, 1874	18	107	1	1875	12,600.00	10,972.61	1,627.39
Museum and herbarium	do June 23, 1874	18 18	107 227	1 1	1875	4,500.00	3,300.00	1,020.00
Laboratory	do	18	227	1	1875	1,300.00	1,300.00	....
Library	do	18	227	1	1875	1,500.00	1,087.90	412.10
Postage	June 20, 1874	18	107	1	1875	52,000.00	42,633.00	9,367.00
To publish Commissioner's report for the years 1872 and 1873	June 23, 1874	18	227	1	1875	50,000.00	49,561.91	438.09
Salaries	Mar. 3, 1875	18	368	1	1876	77,180.00	77,115.71	64.29
Collecting agricultural statistics	do	18	368	1	1876	15,000.00	14,500.00	500.00
Purchase and distribution of seeds	do	18	368	1	1876	65,000.00	65,000.00	....
Experimental garden and grounds	do	18 18	368 394	1 1	1876	19,990.00	19,956.11	33.89
Museum and herbarium	do	18	368	1	1876	2,000.00	1,993.55	6.45
Furniture, cases, and repairs	do	18	368	1	1876	3,300.00	3,124.23	175.77
Library	do	18	368	1	1876	1,250.00	1,046.84	203.16
Laboratory	do	18	368	1	1876	1,300.00	1,300.00	....
Contingent expenses	do	18	368	1	1876	12,100.00	11,378.91	721.09
Postage	do	18	368	1	1876	52,000.00	3,428.29	48,571.71
Salaries	July 21, 1876 Aug. 15, 1876	19 19	95 167	1 1	1877	67,836.96	67,806.19	30.77
Experimental garden and grounds	July 31, 1876 Aug. 15, 1876	19 19	115 167	1 1	1877	11,550.00	11,550.00	....
Collecting agricultural statistics	do	19	167	1	1877	10,000.00	10,000.00	....
Purchase and distribution of seeds, etc	do Mar. 3, 1877	19 19	167 319	1 1	1877	85,000.00	80,000.00	5,000.00
Museum and herbarium	Aug. 15, 1876	19	167	1	1877	2,000.00	2,000.00	....
Furniture, cases, and repairs	do	19	167	1	1877	2,000.00	2,000.00	....
Library	do	19	167	1	1877	1,000.00	800.00	200.00
Laboratory	do	19	167	1	1877	1,300.00	1,300.00	....
Contingent expenses	do	19	167	1	1877	10,000.00	8,800.00	1,200.00
Postage	do	19	167	1	1877	4,000.00	3,950.00	50.00
Salaries	Mar. 3, 1877	19	317	1	1878	65,640.00	65,640.00	....
Collecting agricultural statistics	do	19	317	1	1878	15,000.00	15,000.00	....
Purchase and distribution of seeds, etc	do	19	317	1	1878	75,000.00	74,579.33	420.67
Experimental garden and grounds	do	19 19	317 360	1 1	1878	10,500.00	10,500.00	....

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Museum	Mar. 3, 1877	19	317	1	1878	$1,500.00	$1,500.00	....
Furniture, cases, and repairs	do	19	317	1	1878	4,500.00	4,500.00	....
Library	do	19	317	1	1878	1,000.00	1,000.00	....
Laboratory	do	19	317	1	1878	1,000.00	1,000.00	....
Contingent expenses	do	19	317	1	1878	8,000.00	8,000.00	....
Postage	do	19	317	1	1878	4,000.00	3,415.61	$584.39
Report on forestry	do	19	360	1	1878	2,500.00	2,500.00	....
International Industrial Exposition at Paris	Dec. 15, 1877	20	246	4	1878	10,000.00	10,000.00	....
Salaries	June 19, 1878	20	203	1	1879	66,900.00	66,900.00	....
Collecting agricultural statistics	do	20	203	1	1879	10,000.00	10,000.00	....
Purchase and distribution of seeds, etc	do	20	203	1	1879	75,000.00	75,000.00	....
Experimental garden and grounds	do	20 20	203 240	1 1	1879	13,500.00	13,500.00	....
Museum	do	20	203	1	1879	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	20	204	1	1879	4,000.00	4,000.00	....
Library	do	20	204	1	1879	1,000.00	1,000.00	....
Laboratory	do	20	204	1	1879	1,500.00	1,500.00	....
Contingent expenses	do	20	204	1	1879	8,000.00	8,000.00	....
Postage	do	20	204	1	1879	4,000.00	3,960.00	40.00
Investigating the history and habits of insects	do	20	204	1	1879	10,000.00	10,000.00	....
Investigating diseases of domestic animals	do	20	240	1	1879	10,000.00	10,000.00	....
To erect a stable	Mar. 3, 1879	20	392	1	1879	1,500.00	1,500.00	....
Salaries	June 21, 1879	21	23	1	1880	66,900.00	66,900.00	....
Collecting agricultural statistics	do	21	23	1	1880	10,000.00	9,982.88	17.12
Purchase and distribution of seeds, etc	do	21	23	1	1880	75,000.00	75,000.00	....
Experimental garden and grounds	do	21	23	1	1880	13,100.00	13,100.00	....
Museum	do	21	23	1	1880	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	21	23	1	1880	4,000.00	4,000.00	....
Library	do	21	23	1	1880	1,000.00	1,000.00	....
Laboratory	do	21	23	1	1880	1,500.00	1,500.00	....
Contingent expenses	do	21	23	1	1880	8,000.00	8,000.00	....
Postage	do	21	23	1	1880	4,000.00	4,000.00	....
Investigating the history and habits of insects	do	21	29	1	1880	5,000.00	5,000.00	....
Investigating diseases of domestic animals	do	21	30	1	1880	10,000.00	8,878.84	1,121.16
Salaries	June 16, 1880	21	292	1	1881	69,200.00	69,185.22	14.78
Purchase and distribution of seeds, etc	do May 3, 1881	21 21	294 453	1 1	1881	102,160.31	102,157.48	2.83
Collecting agricultural statistics	June 16, 1880	21	293	1	1881	10,000.00	9,985.60	14.40
Experimental garden and grounds	do	21	294	1	1881	12,600.00	12,600.00	....
Museum	do	21	294	1	1881	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	21	294	1	1881	5,000.00	5,000.00	....
Library	do	21	294	1	1881	1,000.00	1,000.00	....
Laboratory	do	21	295	1	1881	4,000.00	4,000.00	....
Contingent expenses	do	21	295	1	1881	10,000.00	9,769.17	230.83
Postage	do	21	295	1	1881	4,000.00	3,838.00	162.00
Report on forestry	do	21	296	1	1881	5,000.00	3,762.51	1,237.49
Investigating the history and habits of insects	do	21	294	1	1881	5,000.00	4,997.31	2.69
Investigating the diseases of domestic animals	do	21	295	1	1881	10,000.00	10,000.00	....
Examination of fibers	do	21	295	1	1881	4,000.00	4,000.00	....
Experiments in the manufacture of sugar	do	21	295	1	1881	7,500.00	7,500.00	....
Collecting data touching arid regions of the United States	do	21	295	1	1881	5,000.00	460.00	4,540.00
Reclamation of arid lands	do	21	295	1	1881	20,000.00	18,353.55	(a)
Salaries	Mar. 3, 1881	21	381	1	1882	79,500.00	79,491.81	8.19
Collecting agricultural statistics	do	21	382	1	1882	10,000.00	10,000.00	....
Laboratory	do	21	382	1	1882	6,000.00	5,811.85	188.15

[a] Unexpended balance of $1,646.45 carried to fiscal year 1882.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Purchase and distribution of seeds, etc.	Mar. 3, 1881 Apr. 16, 1882	21 22	382 44	1 1	1882	$100,000.00	$99,991.53	$8.47
Experiments in the culture, etc., of tea	Mar. 3, 1881	21	383	1	1882	10,000.00	8,750.87	1,249.13
Experimental garden and grounds	do	21 21	383 385	1 1	1882	15,000.00	14,968.25	31.75
Museum	do	21	383	1	1882	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	21	383	1	1882	4,000.00	4,000.00	....
Library	do	21	383	1	1882	1,000.00	973.85	26.15
Investigating the history and habits of insects	do	21	383	1	1882	20,000.00	19,998.94	1.06
Examination of fibers	do	21	384	1	1882	5,000.00	5,000.00	....
Investigating the diseases of domestic animals	do	21	384	1	1882	25,000.00	22,443.89	2,556.11
Collecting data touching the arid regions of the United States	do	21	384	1	1882	5,000.00	4,216.55	783.45
Reclamation of arid lands, including an unexpended balance of $1,646.45 from fiscal year 1881	do	21	384	1	1882	11,646.45	11,561.19	(a)
Report on forestry	do	21	384	1	1882	5,000.00	4,941.00	59.00
Postage	do	21	384	1	1882	4.000.00	4,000.00	....
Contingent expenses	do	21	384	1	1882	10,000.00	10,000.00	....
Building for display of agricultural implements	do	21	385	1	1882	10,000.00	10,000.00	....
Experiments in the manufacture of sugar (including $864.60 from sale of molasses, etc.)	do	21	384	1	1882	35,864.60	32,333.75	(b)
Transportation of specimens from Atlanta	Feb. 13, 1882	22	3	1	1882	5,000.00	4,998.91	1.09
Salaries	May, 19, 1882	22	89	1	1883	102,580.00	102,575.49	4.51
Collecting agricultural statistics	do	22	90	1	1883	80,000.00	78,170.80	1,829.20
Laboratory	do	22	90	1	1883	6,000.00	6,000.00	....
Purchase and distribution of seeds, etc	do	22	90	1	1883	80,000.00	80,000.00	....
Experiments in the culture, etc., of tea	do	22	91	1	1883	5,000.00	3,905.66	1,094.34
Experimental garden and grounds	do	22 22	91 92	1 1	1883	15,500.00	15,471.82	28.18
Museum	do	22	91	1	1883	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	22	91	1	1883	6,700.00	6,700.00	....
Library	do	22	91	1	1883	1,500.00	1,485.32	14.68
Investigating the history and habits of insects	do	22	91	1	1883	20,000.00	19,997.75	2.25
Examination of fibers	do	22	91	1	1883	10,000.00	7,961.94	2,038.06
Investigating the diseases of domestic animals	do	22	92	1	1883	25,000.00	21,584.28	3,415.72
Reclamation of arid lands, including an unexpended balance of $85.26 from fiscal year 1882	do	22	92	1	1883	20,085.26	12,429.13	(c)
Report on forestry	do	22	92	1	1883	10,000.00	8,731.99	1,268.01
Postage	do	22	92	1	1883	4,000.00	3,977.49	22.51
Contingent expenses	do	22	92	1	1883	15,000.00	14,920.74	79.26
Experiments in the manufacture of sugar, including an unexpended balance of $3,530.85 from fiscal year 1882	do	22	92	1	1883	28,530.85	28,529.31	1.54
Erection of building for seed division	Aug. 7, 1882	22	306	1	1883	25,000.00	25,000.00	....
Report on the Angora goat	do	22	337	1	1883	500.00	500.00	....
Salaries	Jan. 20, 1883	22	408	1	1884	127,640.00	127,639.87	.13
Collecting agricultural statistics	do	22	410	1	1884	80,000.00	79,770.86	229.14
Laboratory, and for experiments in the manufacture of sugar, including $842.18 from the sale of sirup, etc	do	22	410	1	1884	16,842.18	16,829.26	12.92

[a] Unexpended balance of $85.26 carried to fiscal year 1883.

[b] Unexpended balance of $3,530.85 carried to fiscal year 1883.

[c] Unexpended balance of $7,656.13 carried to fiscal year 1884.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Reference to Statutes at Large. Page.	Reference to Statutes at Large. Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Purchase and distribution of seeds, etc	Jan. 20, 1883	22	410	1	1884	$75,000.00	$74,986.48	$13.52
Experimental gardens and grounds	....do	22 22	409 411	1 1	1884	15,500.00	15,448.87	51.13
Museum	....do	22	409	1	1884	1,000.00	993.51	6.49
Furniture, cases, and repairs	....do	22	410	1	1884	6,000.00	5,998.82	1.18
Library	....do	22	411	1	1884	1,500.00	1,439.86	60.14
Investigating the history and habits of insects	....do Aug. 4, 1886	22 24	409 273	1 1	1884	20,002.82	20,002.82	....
Reclamation of arid lands, including an unexpended balance of $7,656.13 from fiscal year 1883	Jan. 20, 1883	22	411	1	1884	17,656.13	16,164.68	1,491.45
Investigating the diseases of domestic animals	....do	22	411	1	1884	25,000.00	24,011.85	988.15
Report on forestry	....do	22	411	1	1884	10,000.00	9,998.30	1.70
Postage	....do	22	411	1	1884	4,000.00	3,841.48	158.52
Contingent expenses	....do	22	411	1	1884	14,000.00	13,991.43	8.57
Building of greenhouse	....do	22	631	1	1884	2,500.00	2,500.00	....
Salaries	June 5, 1884	23	36	1	1885	137,590.00	137,557.80	32.20
Collecting agricultural statistics	....do	23	38	1	1885	100,000.00	99,986.59	13.41
Bureau of Animal Industry	May 29, 1884	23	31	1	1885	150,000.00	56,807.73	(a)
Purchase and distribution of seeds, etc	June 5, 1884	23	38	1	1885	100,000.00	99,983.82	16.18
Laboratory, and for experiments in the manufacture of sugar	....do	23	38	1	1885	50,000.00	49,996.70	3.30
Investigating the history and habits of insects	....do	23	37	1	1885	20,000.00	19,986.83	13.17
Silk culture	....do	23	39	1	1885	15,000.00	14,916.23	83.77
Contingent expenses	....do	23	39	1	1885	15,000.00	14,862.20	137.80
Report on forestry	....do	23	39	1	1885	10,000.00	9,987.36	12.64
Experimental garden and grounds	....do Oct. 19, 1888	23 25	37 581	1 1	1885	17,840.25	17,513.67	326.58
Furniture, cases, and repairs	June 5, 1884	23	38	1	1885	6,000.00	5,947.27	52.73
Postage	....do	23	39	1	1885	4,000.00	3,956.98	43.02
Experiments in the culture, etc., of tea	....do	23	39	1	1885	3,000.00	2,998.90	1.10
Library	....do	23	39	1	1885	1,500.00	1,403.63	96.37
Museum	....do	23	37	1	1885	1,000.00	1,000.00	....
Quarantine stations	June 7, 1884	23	207	1	1885	25,000.00	22,029.18	(b)
Salaries	Mar. 3, 1885	23	353	1	1886	137,590.00	137,337.42	252.58
Collecting agricultural statistics	....do	23	355	1	1886	75,000.00	68,723.06	6,276.94
Bureau of Animal Industry, including an unexpended balance of $93,192.27 from fiscal year 1885	....do	23	355	1	1886	193,192.27	58,261.05	134,931.22
Quarantine stations, including an unexpended balance of $2,970.82 for fiscal year 1885	....do	23	356	1	1886	32,970.82	18,958.57	14,012.25
Purchase and distribution of seeds, etc	....do	23	354	1	1886	100,000.00	99,980.24	19.76
Laboratory, and for experiments in the manufacture of sugar	....do	23	354	1	1886	40,000.00	39,942.11	57.89
Investigating the history and habits of insects	....do	23	354	1	1886	25,000.00	24,976.46	23.54
Silk culture	....do Oct. 19, 1888	23 25	356 581	1 1	1886	15,012,00	15,008.50	3.50
Contingent expenses	Mar. 3, 1885	23	356	1	1886	15,000.00	14,937.62	62.38
Report on forestry	....do	23	356	1	1886	10,000.00	9,836.83	163.17
Experimental garden and grounds	....do Aug. 4, 1886 Oct. 19, 1888	23 24 25	254 273 581	1 1 1	1886	17,208.13	17,024.88	183.25
Furniture, cases, and repairs	Mar. 3, 1885	23	354	1	1886	7,500.00	7,423.59	76.41
Postage	....do	23	356	1	1886	4,000.00	2,556.20	1,443.80
Experiments in the culture, etc., of tea	....do	23	356	1	1886	3,000.00	1,813.67	1,186.33
Library	....do	23	355	1	1886	1,500.00	1,417.03	82.97
Museum	....do	23	354	1	1886	1,000.00	998.88	1.12
Salaries	June 30, 1886	24	100	1	1887	142,890.00	141,420.68	1,469.32

[a] Unexpended balance of $93,192.27 carried to fiscal year 1886.
[b] Unexpended balance of $2,970.82 carried to fiscal year 1886.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collecting agricultural statistics	June 30, 1886	24	103	1	1887	$65,000.00	$64,955.14	$44.86
Bureau of Animal Industry	do	24	103	1	1887	100,000.00	99,985.56	14.44
Quarantine stations	do	24	103	1	1887	30,000.00	10,639.44	19,360.56
Purchase and distribution of seeds, etc	do	24	102	1	1887	100,000.00	99,998.37	1.63
Laboratory	do	24	101	1	1887	6,000.00	4,570.86	1,429.14
Experiments in the manufacture of sugar, including $1,891 from sales	do	24	101	1	1887	95,891.00	95,853.14	37.86
Investigating the history and habits of insects	do Oct. 19, 1888	24 25	101 582	1 1	1887	15,096.25	15,088.05	8.20
Silk culture, including $864.81 from sale of raw silk	June 30, 1886 Oct. 19, 1888	24 25	101 581	1 1	1887	15,939.56	15,939.56	....
Contingent expenses	June 30, 1886	24	104	1	1887	15,000.00	14,936.83	63.17
Report on forestry	do	24	103	1	1887	8,000.00	7,953.50	46.50
Experimental garden and grounds	do	24	102	1	1887	23,200.00	22,202.15	997.85
Furniture, cases, and repairs	do	24	103	1	1887	8,125.00	8,092.11	32.89
Postage	do	24	104	1	1887	4,000.00	3,500.00	500.00
Experiments in the culture, etc., of tea	do	24	104	1	1887	2,000.00	1,753.78	246.22
Pomological information	do	24	100	1	1887	3,000.00	2,993.20	6.80
Library	do	24	103	1	1887	1,500.00	1,428.65	71.35
Botanical investigations	do	24	100	1	1887	5,000.00	4,988.12	11.88
Museum	do	24	102	1	1887	1,000.00	998.88	1.12
Ornithology and mammalogy	do	24	101	1	1887	10,000.00	9,999.98	.02
Reclamation of arid lands	do	24	103	1	1887	5,000.00	....	5,000.00
Adulteration of food	do	24	100	1	1887	1,000.00	989.14	10.86
Salaries	Mar. 3, 1887	24	495	1	1888	161,490.00	158,220.87	3,269.13
Collecting agricultural statistics	do	24	498	1	1888	65,000.00	64,965.33	34.67
Bureau of Animal Industry, including $100,000 immediately available	do	24	499	1	1888	500,000.00	499,975.32	24.68
Quarantine stations	do	24	499	1	1888	20,000.00	9,538.75	10,461.25
Purchase and distribution of seeds, etc	do	24	498	1	1888	103,000.00	102,587.55	412.45
Laboratory	do	24	497	1	1888	6,000.00	5,969.89	30.11
Experiments in the manufacture of sugar	do	24	497	1	1888	50,000.00	49,997.43	2.57
Experiments in the manufacture of sugar (deficiency)	Oct. 19, 1888	25	582	1	1887 1888	8,000.00	7,927.50	72.50
Investigating the history and habits of insects	Mar. 3, 1887	24	497	1	1888	20,000.00	20,000.00	....
Silk culture including $1,989.06 from sale of raw silk	do	24	497	1	1888	16,989.06	16,989.02	.04
Contingent expenses	do	24	499	1	1888	15,000.00	14,825.57	174.43
Report on forestry	do	24	499	1	1888	8,000.00	7,996.10	3.90
Experimental garden and grounds	do	24	497	1	1888	24,800.00	24,706.86	93.14
Furniture, cases, and repairs	do	24	498	1	1888	7,000.00	6,982.88	17.12
Postage	do	24	499	1	1888	4,000.00	3,000.00	1,000.00
Pomological information	do	24	497	1	1888	3,000.00	2,971.69	28.31
Library	do	24	499	1	1888	2,000.00	1,983.78	16.22
Botanical investigations	do	24	496	1	1888	7,000.00	6,997.28	2.72
Museum	do	24	497	1	1888	1,000.00	947.41	52.59
Ornithology and mammalogy	do	24	497	1	1888	3,940.00	3,869.23	70.77
Adulteration of food	do	24	497	1	1888	1,000.00	830.16	169.84
Salaries	July 18, 1888 Mar. 2, 1889	25 25	328 923	1 1	1889	171,890.32	169,152.51	2,737.81
Collecting agricultural statistics	July 18, 1888	25	332	1	1889	70,000.00	69,162.45	837.55
Botanical investigations	do	25	330	1	1889	35,000.00	22,076.75	(a)
Investigating the history and habits of insects	do Sept. 30, 1890	25 26	331 525	1 1	1889	20,131.64	20,131.64	....
Ornithology and mammalogy	July 18, 1888 Mar. 2, 1889 Sept. 30, 1890 Mar. 3, 1891	25 25 26 26	332 838 525 880	1 1 1 1	1889	5,025.90	5,022.06	3.84
Pomological information	July 18, 1888	25 26	330 526	1 1	1889	4,024.48	4,020.32	4.16
Microscopical investigations	do	25	330	1	1889	1,000.00	999.87	.13
Laboratory	do Mar. 2, 1889	25 25	330 837	1 1	1889	11,000.00	9,994.25	1,005.75

[a] Unexpended balance of $12,923.25 carried to fiscal year 1890.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forestry investigations	July 18, 1888	25	333	1	1889	$8,000.00	$7,999.03	$0.97
Purchase and distribution of seeds	do	25	332	1	1889	104,200.00	104,168.73	31.27
Experimental gardens and grounds	do	25	332	1	1889	26,640.00	26,639.83	.17
Museum	do	25	332	1	1889	1,000.00	891.25	108.75
Furniture, cases, and repairs	do	25	333	1	1889	7,350.00	7,236.74	113.26
Library	do	25	333	1	1889	2,000.00	1,956.34	43.66
Postage	do	25	333	1	1889	4,000.00	4,000.00	....
Contingent expenses	do Mar. 3, 1891	25 26	333 881	1 1	1889	15,010.00	15,009.22	.78
Office of Experiment Stations	July 18, 1888	25	334	1	1889	10,000.00	9,033.77	966.23
Experiments in the manufacture of sugar	do	25	333	1	1889	100,000.00	41,635.24	(a)
Quarantine stations	do	25	333	1	1889	15,000.00	11,628.39	3,371.61
Bureau of Animal Industry	do	25	333	1	1889	500,000.00	479,623.57	20,376.43
Silk culture, including $708.26 from sale of raw silk	do	25	331	1	1889	23,208.26	23,208.26	....
Salaries	Mar. 2, 1889	25	835	1	1890	178,580.00	175,547.04	3,032.96
Collecting agricultural statistics	do	25	839	1	1890	75,000.00	74,327.51	672.49
Botanical investigations, including an unexpended balance of $12,923.25 from fiscal year 1889	do July 28, 1892	25 27	836 296	1 1	1890	48,009.25	47,990.38	18.87
Investigating the history and habits of insects	Mar. 2, 1889	25	837	1	1890	20,000.00	19,892.72	107.28
Ornithology and mammalogy	do July 14, 1890	25 26	838 285	1 1	1890	7,000.00	6,994.16	5.84
Pomological information	Mar. 2, 1889 Mar. 3, 1891	25 26	837 881	1 1	1890	4,304.79	4,304.79	....
Microscopical investigations	Mar. 2, 1889 July 28, 1892	25 27	837 296	1 1	1890	1,062.50	1,062.50	....
Laboratory	Mar. 2, 1889	25	837	1	1890	6,000.00	5,461.99	538.01
Forestry investigations	do	25	840	1	1890	8,000.00	7,999.96	.04
Purchase and distribution of seeds	do	25	839	1	1890	104,200.00	104,174.55	25.45
Experimental garden and grounds	do	25	838	1	1890	26,640.00	26,478.45	161.55
Museum	do	25	838	1	1890	1,000.00	998.39	1.61
Furniture, cases, and repairs	do Apr. 4, 1890	25 26	839 42	1 1	1890	9,350.00	9,261.93	88.07
Library	Mar. 2, 1889	25	839	1	1890	2,000.00	1,738.28	261.72
Postage	do	25	840	1	1890	4,000.00	4,000.00	....
Contingent expenses	do Apr. 4, 1890	25 26	840 42	1 1	1890	20,000.00	19,965.32	34.68
Office of Experiment Stations	Mar. 2, 1889	25	840	1	1890	15,000.00	14,991.69	8.31
Experiments in the manufacture of sugar, including an unexpended balance of $58,364.76 from fiscal year 1889	do	25	840	1	1890	83,364.76	83,064.14	300.62
Quarantine stations	do	25	840	1	1890	15,000.00	11,266.24	3,733.76
Bureau of Animal Industry	do	25	839	1	1890	500,000.00	311,025.31	(b)
Silk culture, including $1,627.81 from sale of raw silk	do	25	837	1	1890	21,627.81	21,626.10	1.71
Artesian wells	Apr. 4, 1890	26	42	1	1890	20,000.00	19,652.17	347.83
Salaries	July 14, 1890	26	282	1	1891	248,902.85	239,923.29	8,979.56
Collecting agricultural statistics	do	26	284	1	1891	100,000.00	85,126.44	14,873.56
Botanical investigations	do	26	284	1	1891	40,000.00	36,428.36	3,571.64
Investigating the history and habits of insects	do July 28, 1892	26 27	285 296	1 1	1891	27,501.77	27,481.00	20.77
Ornithology and mammalogy	July 14, 1890 July 28, 1892	26 27	285 296	1 1	1891	14,004.90	13,003.67	1,001 23
Pomological information	July 14, 1890	26	285	1	1891	5,000.00	4,983.88	16.12
Microscopical investigations	do	26	285	1	1891	5,000.00	3,281.90	1,718.10
Vegetable pathology	do	26	285	1	1891	15,000.00	14,995.75	4.25
Laboratory	do	26	286	1	1891	20,200.00	19,985.27	214.73
Forestry investigations	do	26	286	1	1891	10,000.00	9,785.99	214.01
Illustrations and engravings	do	26	286	1	1891	2,000.00	1,999.58	.42
Purchase and distribution of seeds	do	26	286	1	1891	105,400.00	105,090.94	309.06

[a] Unexpended balance of $58,364.76 carried to fiscal year 1890.

[b] Unexpended balance of $188,974.69 carried to fiscal year 1891.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Page.	Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Document and folding room	July 14, 1890	26	287	1	1891	$2,000.00	$1,995.53	$4.47
Experimental garden and grounds	....do	26	287	1	1891	28,500.00	28,396.41	103.59
Museum	....do	26	287	1	1891	4,000.00	3,832.28	167.72
Furniture, cases, and repairs	....do Mar. 3, 1891	26 26	287 1049	1 1	1891	12,000.00	11,991.01	8.99
Library	July 14, 1890	26	287	1	1891	3,000.00	2,997.20	2.80
Postage	....do	26	287	1	1891	5,000.00	4,833.00	167.00
Contingent expenses	....do	26	287	1	1891	20,000.00	18,097.13	1,902.87
Office of Experiment Stations	....do	26	288	1	1891	15,000.00	14,984.48	15.52
Experiments in the manufacture of sugar	....do Mar. 3, 1891	26 26	288 1050	1 1	1891	75,000.00	74,901.18	98.82
Irrigation investigations	Sept. 30, 1890	26	525	1	1891	40,000.00	39,926.67	73.33
Quarantine stations	July 14, 1890	26	288	1	1891	15,000.00	13,586.72	1,413.28
Bureau of Animal Industry, including an unexpended balance of $188,974.69 from fiscal year 1890	....do	26	287	1	1891	538,974.69	469,113.35	69,861.34
Silk culture, including $565 from sale of raw silk	....do	26	285	1	1891	20,565.00	19,536.33	1,028.67
Salaries	Mar. 3, 1891	26	1045	1	1892	256,800.00	252,766.17	4,033.83
Collecting agricultural statistics	....do	26	1046	1	1892	102,500.00	88,869.51	13,630.49
Botanical investigations	....do Aug. 23, 1894	26 28	1046 440	1 1	1892	40,246.40	40,246.40	....
Investigating the history and habits of insects	Mar. 3, 1891	26	1047	1	1892	27,800.00	27,780.03	19.97
Ornithology and mammalogy	....do	26	1047	1	1892	15,000.00	14,688.00	312.00
Pomological information	....do	26	1047	1	1892	5,000.00	4,985.27	14.73
Microscopical investigations	....do	26	1047	1	1892	2,000.00	1,251.46	748.54
Vegetable pathology	....do Aug. 23, 1894	26 28	1047 440	1 1	1892	15,076.47	15,076.47	....
Laboratory	Mar. 3, 1891	26	1047	1	1892	19,400.00	19,272.59	127.41
Fiber investigations	....do	26	1048	1	1892	10,000.00	8,017.44	1,982.56
Forestry investigations	....do Mar. 3, 1893	26 27	1048 660	1 1	1892	15,056.85	15,056.85	....
Illustrations and engravings	Mar. 3, 1891	26	1048	1	1892	2,000.00	1,999.85	.15
Purchase and distribution of seeds	....do	26	1048	1	1892	105,400.00	104,920.35	479.65
Document and folding room	....do	26	1049	1	1892	2,000.00	1,996.82	3.18
Experimental garden and grounds	....do Mar. 3, 1893	26 27	1049 660	1 1	1892	28,622.53	28,536.67	85.86
Museum	Mar. 3, 1891	26	1049	1	1892	4,000.00	3,909.17	90.83
Furniture, cases, and repairs	....do	26	1049	1	1892	10,000.00	9,996.55	3.45
Library	....do	26	1049	1	1892	3,000.00	2,807.75	192.25
Postage	....do	26	1049	1	1892	5,000.00	4,900.00	100.00
Contingent expenses	....do	26	1049	1	1892	25,000.00	24,762.32	237.68
Office of Experiment Stations	....do	26	1050	1	1892	20,000.00	19,989.47	10.53
Experiments in the manufacture of sugar	....do Mar. 18, 1892	26 27	1050 7	1 1	1892	35,000.00	34,627.78	372.22
Quarantine stations	Mar. 3, 1891	26	1050	1	1892	15,000.00	14,983.63	16.37
Bureau of Animal Industry	....do Mar. 18, 1892	26 27	1045 7	1 1	1892	650,000.00	649,980.91	19.09
Weather Bureau	Mar. 3, 1891	26	1051	1	1892	889,753.50	861,840.83	27,912.67
Salaries	July 5, 1892	27	74	1	1893	256,800.00	253,896.30	2,903.70
Collecting agricultural statistics	....do	27	76	1	1893	110,000.00	95,649.21	14,350.79
Botanical investigations and experiments	....do	27	76	1	1893	27,500.00	27,451.55	48.45
Investigating the history and habits of insects	....do	27	77	1	1893	17,800.00	17,290.80	509.20
Investigations in ornithology and mammalogy	....do	27	77	1	1893	15,000.00	14,947.77	52.23
Pomological information	....do	27	77	1	1893	5,000.00	4,745.94	254.06
Microscopical investigations	....do	27	77	1	1893	2,000.00	1,982.98	17.02
Vegetable pathology	....do	27	77	1	1893	20,000.00	19,977.38	22.62
Laboratory	....do	27	77	1	1893	19,400.00	18,002.59	1,397.41
Fiber investigations	....do	27	78	1	1893	5,000.00	4,997.07	2.93
Forest investigations	....do	27	78	1	1893	12,000.00	11,933.39	66.61
Illustrations and engravings	....do	27	78	1	1893	2,000.00	1,906.73	93.27
Purchase and distribution of seeds	....do	27	78	1	1893	135,400.00	134,908.27	491.73
Document and folding room	....do	27	78	1	1893	2,000.00	1,623.55	376.45
Experimental garden and grounds	....do	27	78	1	1893	28,500.00	28,115.09	384.91

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Museum	July 5, 1892	27	79	1	1893	$4,000.00	$3,973.67	$26.33
Furniture, cases, and repairs	do	27	79	1	1893	10,000.00	8,931.97	1,068.03
Library	do	27	79	1	1893	3,000.00	2,535.29	464.71
Postage	do	27	79	1	1893	5,000.00	3,705.00	1,295.00
Contingent expenses	do	27	79	1	1893	25,000.00	22,218.19	2,781.81
Experiment stations	do	27	80	1	1893	20,000.00	18,987.65	1,012.35
Experiments in the manufacture of sugar	do	27	80	1	1893	20,000.00	19,984.86	15.14
Irrigation investigations	do	27	76	1	1893	6,000.00	4,930.67	1,069.33
Quarantine stations	do	27	80	1	1893	15,000.00	12,633.23	2,366.77
Experiments in the production of rainfall	do	27	76	1	1893	10,000.00	4,979.59	5,020.41
Bureau of Animal Industry	do	27	79	1	1893	850,000.00	724,696.74	125,303.26
Weather Bureau	do	27	81	1	1893	913,660.72	890,424.77	23,235.95
Salaries	Mar. 3, 1893	27	734	1	1894	256,800.00	233,679.75	23,120.25
Collecting agricultural statistics	do	27	736 737	1	1894	110,000.00	91,080.20	18,919.80
Botanical investigations and experiments	do	27	737	1	1894	30,000.00	24,401.40	5,598.60
Investigating the history and habits of insects	do	27	737	1	1894	20,300.00	16,203.96	4,096.04
Investigations in ornithology and mammalogy	do	27	737	1	1894	17,500.00	17,450.00	50.00
Pomological information	do	27	738	1	1894	5,000.00	4,248.99	751.01
Microscopical investigations	do	27	738	1	1894	2,000.00	1,117.55	882.45
Vegetable pathology	do	27	738	1	1894	20,900.00	17,576.95	2,423.05
Laboratory	do	27	738	1	1894	21,900.00	10,426.79	11,473.21
Fiber investigations	do	27	738	1	1894	5,000.00	2,500.47	2,499.53
Forestry investigations	do	27	738	1	1894	20,000.00	19,995.96	4.04
Illustrations and engravings	do	27	738	1	1894	2,000.00	664.79	1,335.21
Purchase and distribution of seeds	do	27	738	1	1894	135,400.00	119,719.76	15,680.24
Document and folding room	do	27	739	1	1894	2,000.00	1,662.81	337.19
Experimental garden and grounds	do	27	739	1	1894	31,500.00	26,616.86	4,883.14
Museum	do	27	739	1	1894	4,000.00	2,787.22	1,212.78
Furniture, cases, and repairs	do	27	739	1	1894	10,000.00	8,628.76	1,371.24
Library	do	27	739	1	1894	3,000.00	2,900.07	99.93
Postage	do	27	740	1	1894	5,000.00	1,375.00	3,625.00
Contingent expenses	do	27	740	1	1894	25,000.00	20,493.04	4,506.96
Experiment stations	do	27	740	1	1894	25,223.50	22,381.85	2,841.65
Inquiries relating to public roads	do	27	737	1	1894	10,000.00	2,997.39	7,002.61
Experiments in the manufacture of sugar	do	27	741	1	1894	20,107.33	9,451.80	10,655.53
Irrigation investigations	do	27	741	1	1894	6,000.00	5,475.92	524.08
Quarantine stations	do	27	740	1	1894	15,000.00	6,263.92	8,736.08
Bureau of Animal Industry	do	27	740	1	1894	850,000.00	496,111.34	353.888.66
Weather Bureau	do	27	741	1	1894	951,124.75	811,256.73	139,868.02
Salaries	Aug. 18, 1894	28	266	1	1895	249,876.16	204,589.72	45,286.44
Collecting agricultural statistics	do	28	266	1	1895	110,000.00	95,125.67	14,874.33
Botanical investigations and experiments	do	28	267	1	1895	30,000.00	25,695.30	4,304.70
Ivestigating the history and habits of insects	do	28	267	1	1895	20,300.00	16,822.87	3,477.13
Investigations in ornithology, etc	do	28	267	1	1895	17,500.00	15,526.35	1,973.65
Pomological information	do	28	267	1	1895	5,000.00	4,920.23	79.77
Microscopical investigations	do	28	267	1	1895	2,000.00	313.87	1,686.13
Vegetable pathological investigations, etc	do	28	267	1	1895	20,000.00	19,063.69	936.31
Laboratory	do	28	267	1	1895	14,900.00	11,010.50	3,889.50
Fiber investigations	do	28	271	1	1895	5,000.00	3,973.81	1,026.19
Report on forestry	do	28	268	1	1895	20,000.00	19,908.23	91.77
Illustrations and engravings	do	28	268	1	1895	15,000.00	9,114.71	5,855.29
Purchase and distribution of valuable seeds	do	28	269	1	1895	165,400.00	120,545.15	44,854.85
Document and folding room	do	28	268	1	1895	2,000.00	1,166.83	833.17
Experimental gardens and grounds	do	28	268	1	1895	29,500.00	23,578.11	5,921.89
Museum	do	28	271	1	1895	3,000.00	1,889.73	1,110.27
Furniture, cases, and repairs	do	28	271	1	1895	10,000.00	7,952.27	2,047.73
Library	do	28	272	1	1895	6,000.00	5,963.20	36.80
Postage	do	28	271	1	1895	5,000.00	765.00	4,235.00
Nutrition investigations	do	28	271	1	1895	10,000.00	9,746.30	253.70

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
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Contingent expenses	Aug. 18, 1894	28	272	1	1895	$25,000.00	$20,452.79	$4,547.21
Agricultural experiment stations	do	28	271	1	1895	25,000.00	24,928.22	71.78
Inquiries relating to public roads	do	28	266	1	1895	10,000.00	6,901.66	3,098.34
Experiments in the manufacture of sugar	do	28	271	1	1895	10,000.00	6,188.80	3,811.20
Irrigation investigations	do	28	271	1	1895	6,000.00	3,904.88	2,095.12
Quarantine stations for neat cattle	do	28	269	1	1895	12,000.00	6,262.17	5,737.83
Bureau of Animal Industry	do	28	269	1	1895	800,000.00	534,028.38	265,971.62
Weather Bureau	do	28	272	1	1895	878,438.84	820,691.94	57,746.90
Salaries	Mar. 2, 1895	28	727	1	1896	252,840.00	217,066.97	35,773.03
Collecting agricultural statistics	do	28	729	1	1896	110,000.00	68,628.99	41,371.01
Inquiries relating to public roads	do	28	729	1	1896	10,000.00	9,568.39	431.61
Botanical investigations and experiments	do	28	730	1	1896	25,000.00	20,325.37	4,674.63
Investigating the history and habits of insects	do	28	730	1	1896	20,000.00	17,372.43	2,627.57
Investigations in ornithology and mammalogy	do	28	730	1	1896	17,500.00	16,175.45	1,324.55
Pomological information	do	28	730	1	1896	6,000.00	4,996.41	1,003.59
Microscopical investigations	do	28	730	1	1896	2,000.00	....	2,000.00
Vegetable pathological investigations and experiments	do	28	730	1	1896	20,000.00	18,539.18	1,460.82
Laboratory	do	28	730	1	1896	14,900.00	11,458.53	3,441.47
Report on forestry	do	28	731	1	1896	25,000.00	18,398.12	6,601.88
Illustrations and engravings	do	28	731	1	1896	15,000.00	12,985.71	2,014.29
Document and folding room	do	28	731	1	1896	2,000.00	1,061.23	938.77
Experimental gardens and grounds	do	28	731	1	1896	29,500.00	22,371.15	7,128.85
Quarantine stations for neat cattle	do	28	733	1	1896	12,000.00	6,492.05	5,507.95
Purchase and distribution of valuable seeds	do	28	733	1	1896	185,400.00	126,476.87	58,923.13
Experiments in the manufacture of sugar	do	28	734	1	1896	10,000.00	1,510.94	8,489.06
Agricultural experiment stations ($750,000[a])	do	28	734	1	1896	[b] 30,143.75	27,712.86	2,430.89
Irrigation investigations	do	28	735	1	1896	15,000.00	5,029.82	9,970.18
Nutrition investigations	do	28	735	1	1896	15,000.00	14,892.96	107.04
Investigations and experiments with grasses and forage plants	do	28	735	1	1896	15,000.00	13,329.47	1,670.53
Investigations in relation to agricultural soils	do	28	735	1	1896	15,000.00	13,524.84	1,475.16
Furniture, cases, and repairs	do	28	735	1	1896	10,000.00	8,645.98	1,354.02
Postage	do	28	735	1	1896	2,000.00	1,215.00	785.00
Museum	do	28	735	1	1896	3,000.00	2,161.90	838.10
Fiber investigations	do	28	735	1	1896	5,000.00	3,710.36	1,289.64
Library	do	28	735	1	1896	6,000.00	5,431.92	568.08
Contingent expenses	do	28	736	1	1896	25,000.00	15,912.71	9,087.29
Bureau of Animal Industry	do	28	731	1	1896	800,000.00	595,336.64	204,663.36
Weather Bureau	do	28	736	1	1896	[c] 885,729.47	814,584.17	71,145.30
Salaries	Apr. 25, 1896	29	99	1	1897	313,860.00	290,791.95	23,068.05
Furniture, cases, and repairs	do	29	105	1	1897	12,000.00	9,567.59	2,432.41
Library	do	29	104	1	1897	7,000.00	6,831.15	168.85
Museum	do	29	105	1	1897	3,000.00	2,895.45	104.55
Postage	do	29	105	1	1897	3,000.00	1,730.00	1,270.00
Contingent expenses	do	29	105	1	1897	25,000.00	22,980.29	2,019.71
Animal quarantine stations	do	29	105	1	1897	12,000.00	6,564.19	5,435.81
Collecting agricultural statistics	do	29	101	1	1897	110,000.00	83,067.62	26,932.38
Botanical investigations and experiments	do	29	101	1	1897	15,000.00	14,999.64	.36
Entomological investigations	do	29	102	1	1897	20,000.00	18,637.01	1,362.99
Vegetable pathological investigations	do	29	102	1	1897	20,000.00	19,274.15	725.85
Biological investigations	do	29	102	1	1897	17,500.00	17,483.05	16.95
Pomological investigations	do	29	102	1	1897	6,000.00	4,981.52	1,018.48

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[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Includes $143.75 from the sale of card index.

[c] Includes $119.47 from the sale of Weather Bureau publications.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Laboratory	Apr. 25, 1896	29	102	1	1897	$12,400.00	$10,800.18	$1,599.82
Forestry investigations	do	29	103	1	1897	20,000.00	19,514.88	485.12
Experimental gardens and grounds	do	29	103	1	1897	20,000.00	19,483.28	516.72
Soil investigations	do	29	103	1	1897	10,000.00	9,868.16	131.84
Grass and forage plant investigations	do	29	103	1	1897	10,000.00	9,203.14	796.86
Fiber investigations	do	29	103	1	1897	5,000.00	4,143.00	857.00
Agricultural experiment stations ($750,000) [a]	do	29	103	1	1897	[b] 30,127.25	29,171.57	955.68
Nutrition investigations	do	29	104	1	1897	15,000.00	14,821.64	178.36
Public road inquiries	do	29	104	1	1897	8,000.00	7,873.97	126.03
Publications	do	29	104	1	1897	70,000.00	67,709.89	2,290.11
Purchase and distribution of valuable seeds	do	29	106	1	1897	150,000.00	142,822.52	7,177.48
Bureau of Animal Industry	do	29	106	1	1897	650,000.00	642,715.68	7,284.32
Weather Bureau	do	29	107	1	1897	[c] 883,876.28	870,581.46	13,294.82
Salaries, officers and clerks	Apr. 23, 1897	30	1	1	1898	319,300.00	285,181.30 18,962.98 9,811.02	5,118.70 37.02 188.98
Furniture, cases, and repairs	do	30	8	1	1898	9,000.00	7,851.30	1,148.70
Library	do	30	7	1	1898	7,000.00	6,734.81	265.19
Museum	do	30	8	1	1898	3,000.00	2,906.02	93.98
Postage	do	30	8	1	1898	3,000.00	1,500.00	1,500.00
Contingent expenses	do	30	8	1	1898	25,000.00	22,061.73	2,938.27
Animal quarantine stations	do	30	7	1	1898	12,000.00	10,897.98	1,102.02
Collecting agricultural statistics	do	30	3	1	1898	110,000.00	92,896.01 9,021.09	7,103.99 978.91
Botanical investigations and experiments	do	30	4	1	1898	15,000.00	14,714.50	285.50
Entomological investigations	do	30	4	1	1898	20,000.00	19,735.02	264.98
Vegetable pathological investigations	do	30	4	1	1898	20,000.00	18,966.67 660.00	373.33 ....
Biological investigations	do	30	4	1	1898	17,500.00	16,160.90	1,339.10
Pomological investigations	do	30	4	1	1898	8,000.00	7,487.93	512.07
Laboratory	do	30	5	1	1898	12,400.00	3,913.86 900.00 6,718.71	86.14 .... 781.29
Forestry investigations	do	30	5	1	1898	20,000.00	19,831.32	168.68
Experimental gardens and grounds	do	30	5	1	1898	25,000.00	24,937.31	62.69
Soil investigations	do	30	5	1	1898	10,000.00	9,199.82 660.00	140.18 ....
Grass and forage plant investigations	do	30	6	1	1898	10,000.00	8,877.68	1,122.32
Fiber investigations	do	30	6	1	1898	5,000.00	3,659.05	1,340.95
Agricultural experiment stations ($755,000 [a])	do	30	6	1	1898	35,000.00	29,413.10 4,925.80	586.90 74.20
Nutrition investigations	do	30	6	1	1898	15,000.00	14,872.88	127.12
Public road inquiries	do	30	7	1	1898	8,000.00	7,978.44	21.56
Publications, including Farmers' Bulletins	do	30	7	1	1898	65,000.00	34,966.55 29,812.59	33.45 187.41
Investigating production of domestic sugar	do	30	39	1	1898	5,000.00	4,941.32	58.68
Purchase and distribution of valuable seeds	do	30	8	1	1898	130,000.00	121,870.38	8,129.62
Salaries and expenses, Bureau of Animal Industry	do	30	9	1	1898	675,000.00	673,444.02 1,200.00	355.98 ....
Weather Bureau	do	30	9	1	1898	883,702.00	877,838.35	5,863.65
Salaries, officers and clerks	Mar. 22, 1898	30	330	1	1899	319,300.00	315,986.70	3,313.30
Furniture, cases, and repairs	do	30	336	1	1899	9,000.00	8,667.75	332.25
Library	do	30	336	1	1899	6,000.00	5,659.51	340.49
Museum	do	30	336	1	1899	1,500.00	1,465.36	34.64
Postage	do	30	336	1	1899	2,000.00	2,000.00	....
Contingent expenses	do	30	337	1	1899	25,000.00	23,888.08	1,111.92
Animal quarantine stations	do	30	336	1	1899	12,000.00	11,833.38	166.62
Collecting agricultural statistics	do	30	333	1	1899	105,000.00	100,952.48	4,047.52
Botanical investigations and experiments	do	30	333	1	1899	20,000.00	19,972.07	27.93

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.
[b] Includes $127.25 from the sale of card index.
[c] Includes $104.28 from the sale of Weather Bureau publications.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Page.	Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Entomological investigations	Mar. 22, 1898	30	333	1	1899	$20,000.00	$19,812.64	$187.36
Vegetable pathological investigations	do	30	333	1	1899	20,000.00	19,634.32	365.68
Biological investigations	do	30	334	1	1899	17,500.00	17,373.26	126.74
Pomological investigations	do	30	334	1	1899	9,500.00	8,248.18	1,251.82
Laboratory	do	30	334	1	1899	12,400.00	12,028.15	371.85
Forestry investigations	do	30	334	1	1899	20,000.00	19,520.52	469.48
Experimental gardens and grounds	do	30	334	1	1899	20,000.00	19,879.66	120.34
Soil investigations	do	30	334	1	1899	10,000.00	9,885.85	114.15
Grass and forage plant investigations	do	30	335	1	1899	10,000.00	9,950.99	49.01
Irrigation information	do	30	335	1	1899	10,000.00	9,997.49	2.51
Agricultural experiment stations ($760,000 [a])	do	30	335	1	1899	40,000.00	39,536.38	463.62
Nutrition investigations	do	30	335	1	1899	15,000.00	14,903.08	96.92
Public road inquiries	do	30	336	1	1899	8,000.00	7,469.50	530.50
Publications	do	30	336	1	1899	65,000.00	64,773.62	226.38
Purchase and distribution of valuable seeds	do	30	337	1	1899	130,000.00	128,350.61	1,649.39
Investigating production of domestic sugar	do	30	338	1	1899	7,000.00	6,860.30	139.70
Salaries and expenses, Bureau of Animal Industry	do	30	338	1	1899	900,000.00	[b] 920,164.47	6,828.45
Weather Bureau	do	30	339	1	1899	1,015,502.00	1,008,971.30	6,530.70
Salaries, officers and clerks	Mar. 1, 1899	30	947	1	1900	336,340.00	330,666.24	5,673.76
Furniture, cases, and repairs	do	30	955	1	1900	10,000.00	9,771.27	228.73
Library	do	30	954	1	1900	5,000.00	4,291.17	708.83
Museum	do	30	954	1	1900	1,500.00	1,490.01	9.99
Postage	do	30	954	1	1900	2,000.00	2,000.00	....
Contingent expenses	do	30	955	1	1900	25,000.00	23,769.38	1,230.62
Animal quarantine stations	do	30	954	1	1900	12,000.00	11,477.87	522.13
Collecting agricultural statistics	do	30	950	1	1900	110,000.00	107,653.62	2,346.38
Botanical investigations and experiments	do	30	950	1	1900	20,000.00	19,689.51	310.49
Entomological investigations	do	30	951	1	1900	20,000.00	19,920.64	79.36
Vegetable pathological investigations	do	30	951	1	1900	26,000.00	25,854.44	145.56
Biological investigations	do	30	951	1	1900	17,500.00	17,344.00	156.00
Pomological investigations	do	30	951	1	1900	9,500.00	9,099.61	400.39
Laboratory	do	30	951	1	1900	17,700.00	17,182.80	517.20
Forestry investigations	do	30	952	1	1900	40,000.00	39,991.49	8.51
Experimental gardens and grounds	do	30	952	1	1900	28,000.00	27,589.66	410.34
Soil investigations	do	30	952	1	1900	20,000.00	19,717.02	282.98
Grass and forage plant investigations	do	30	952	1	1900	12,000.00	11,566.84	433.16
Irrigation investigations	do	30	953	1	1900	35,000.00	33,732.57	1,267.43
Agricultural experiment stations ($765,000 [a])	do	30	953	1	1900	45,000.00	43,702.20	1 297.80
Nutrition investigations	do	30	953	1	1900	15,000.00	14,950.86	49.14
Public road inquiries	do	30	954	1	1900	8,000.00	7,854.35	145.65
Publications	do	30	954	1	1900	80,000.00	79,516.76	483.24
Purchase and distribution of valuable seeds	do	30	955	1	1900	130,000.00	128,366.13	1,633.87
Investigating production of domestic sugar	do	30	956	1	1900	7,000.00	6,717.82	282.18
Tea-culture investigations	do	30	956	1	1900	1,000.00	999.33	.67
Salaries and expenses, Bureau of Animal Industry	do	30	956	1	1900	950,000.00	918,449.03	31,550.97
Weather Bureau	do	30	957	1	1900	1,022,482.00	1,014,238.80	8,243.20
Salaries, officers and clerks	May 20, 1900	31	191	1	1901	326,680.00	319,809.25	6,870.75
Library	do	31	194	1	1901	5,000.00	4,118.93	881.07
Contingent expenses	do	31	194	1	1901	37,000.00	35,623.95	1,376.05
Animal quarantine stations	do	31	194	1	1901	50,000.00	49,343.52	656.48
Collecting agricultural statistics	do	31	194	1	1901	110,000.00	109,729.76	270.24
Botanical investigations and experiments	do	31	195	1	1901	30,000.00	29,590.49	409.51
Entomological investigations	do	31	195	1	1901	22,500.00	22,265.57	234.43
Vegetable pathological investigations	do	31	195	1	1901	28,000.00	27,488.57	511.43

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Includes $26,992.92 received from sale of American products in Europe.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Page.	Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Biological investigations	Mar. 1, 1899	31	196	1	1901	$17,500.00	$17,195.83	$304.17
Pomological investigations	do	31	196	1	1901	9,500.00	9,315.11	184.89
Laboratory	do	31	196	1	1901	28,500.00	28,395.45	104.55
Forestry investigations	do	31	197	1	1901	80,000.00	79,695.87	304.13
Experimental gardens and grounds	do	31	197	1	1901	20,000.00	19,986.72	13.28
Soil investigations	do	31	197	1	1901	25,000.00	24,924.94	75.06
Grass and forage plant investigations	do	31	198	1	1901	17,000.00	15,225.83	1,774.17
Irrigation investigations	do	31	199	1	1901	50,000.00	49,973.09	26.91
Agricultural experiment stations ($780,000[a])	do	31	198	1	1901	[b] 60,251.01	59,883.47	367.54
Nutrition investigations	do	31	199	1	1901	17,500.00	17,499.67	.33
Arlington experimental farm	do	31	199	1	1901	10,000.00	9,946.03	53.97
Public road inquiries	do	31	200	1	1901	14,000.00	13,990.76	9.24
Publications	do	31	200	1	1901	105,000.00	104,680.67	319.33
Purchase and distribution of valuable seeds	do	31	200	1	1901	170,000.00	149,615.49	20,384.51
Investigating production of domestic sugar	do	31	201	1	1901	7,000.00	6,690.25	309.75
Tea-culture investigations	do	31	202	1	1901	5,000.00	4,959.42	40.58
Salaries and expenses, Bureau of Animal Industry	do	31	202	1	1901	[c]1,000,514.96	976,566.75	23,948.21
Salaries, Weather Bureau	do	31	202	1	1901	153,320.00	152,688.11	631.89
Fuel, lights, and repairs, Weather Bureau	do	31	203	1	1901	9,000.00	8,877.36	122.64
Contingent expenses, Weather Bureau	do	31	203	1	1901	8,000.00	7,906.40	93.60
General expenses, Weather Bureau	do	31	203	1	1901	828,000.00	823,921.78	4,078.22
Meteorological Observation Stations, Weather Bureau	do	31	204	1	1901	60,000.00	59,019.49	980.51
Salaries	Mar. 2, 1901	31	922	1	1902	373,820.00	370,039.69	3,780.31
Library	do	31	934	1	1902	7,000.00	6,754.06	245.94
Contingent expenses	do	31	934	1	1902	37,000.00	34,543.24	2,456.76
Animal quarantine stations	do	31	926	1	1902	25,000.00	24,814.88	185.12
Collecting agricultural statistics	do	31	934	1	1902	120,000.00	117,060.06	2,939.94
Botanical investigations and experiments	do	31	928	1	1902	45,000.00	44,950.93	49.07
Entomological investigations	do	31	931	1	1902	28,513.18	27,069.77	1,443.41
Vegetable pathological investigations	do	31	927	1	1902	60,000.00	59,999.45	.55
Biological investigations	do	31	932	1	1902	20,000.00	19,807.80	192.20
Pomological investigations	do	31	927	1	1902	20,000.00	19,985.14	14.86
Laboratory	do	31	930	1	1902	24,500.00	24,417.47	82.53
Forestry investigations	do	31	929	1	1902	146,280.00	145,809.76	470.24
Experimental gardens and grounds	do	31	929	1	1902	20,000.00	19,725.80	274.20
Soil investigations	do	31	931	1	1902	91,000.00	89,987.21	1,012.79
Grass and forage plant investigations	do	31	928	1	1902	20,000.00	19,566.91	433.09
Irrigation investigations	do	31	936	1	1902	50,000.00	49,980.86	19.14
Agricultural experiment stations ($780,000[a])	do	31	935	1	1902	[d] 69,157.05	69,052.71	104.34
Nutrition investigations	do	31	936	1	1902	20,000.00	19,951.48	48.52
Arlington experimental farm	do	31	936	1	1902	10,000.00	9,897.16	102.84
Plans for building Department of Agriculture, 1901-2	do	31	938	1	1902	5,000.00	5,000.00	....
Public road inquiries	do	31	938	1	1902	20,000.00	19,957.01	42.99
Publications	do	31	933	1	1902	188,000.00	187,657.52	342.48
Purchase and distribution of valuable seeds	do	31	937	1	1902	270,000.00	266,614.22	3,385.78
Investigating production of domestic sugar	do	31	936	1	1902	5,000.00	4,346.31	653.69
Tea-culture investigations	do	31	937	1	1902	7,000.00	6,816.25	183.75
Bureau of Animal Industry	do	31	925	1	1902	1,092,190.28	1,092,100.94	89.34
Weather Bureau:								
Salaries	do	31	923	1	1902	159,820.00	159,769.71	50.59
Fuel, lights, and repairs	do	31	923	1	1902	9,000.00	8,919.71	80.29

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.
[b] Including $251.01 received from sales of card index.
[c] Including $514.96 received from sales of American butter in foreign markets.
[d] Including $157.05 received from sales of card index.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Weather Bureau—Continued.								
Contingent expenses	Mar. 2, 1901	31	923	1	1902	$8.000.00	$7,942.81	$57.19
General expenses	do	31	923	1	1902	865.500.00	864,490.74	1,009.26
Meteorological observation stations	do	31	924	1	1902	60,000.00	59,646.49	353.51
Buildings	do	31	924	1	1902	46,000.00	46,000.00	....
Salaries	June 3, 1902	32	286	1	1903	465,500.00	450,976.17	14,523.83
Library	do	32	300	1	1903	8,000.00	7,635.11	364.89
Contingent expenses	do	32	301	1	1903	37,000.00	42,916.14	83.86
Urgent deficiency, contingent	do	32	1062	1	1903	6,000.00		
Vegetable pathological investigations	do	32	291	1	1903	105,000.00	103,646.28	1,353.72
Vegetable pathological investigations, 1902-3	do	32	1152	1	1903	5,000.00	4,130.02	869.98
Pomological investigations	do	32	291	1	1903	30,000.00	29,606.83	393.17
Botanical investigations and experiments	do	32	292	1	1903	55,000.00	54,900.42	99.58
Grass and forage plant investigations	do	32	292	1	1903	30,000.00	29,527.41	472.59
Experimental gardens and grounds	do	32	293	1	1903	25,000.00	24,935.74	64.26
Arlington Experimental Farm	do	32	293	1	1903	15,000.00	14,998.81	1.19
Investigating production of domestic sugar	do	32	295	1	1903	5,000.00	4,065.10	934.90
Tea-culture investigations	do	32	293	1	1903	10,000.00	7,500.10	2,499.90
Purchase and distribution of valuable seeds	do	32	293	1	1903	270,000.00	266,229.81	3,770.19
Forestry investigations	do	32	295	1	1903	254,000.00	244,781.68	9,218.32
Laboratory	do	32	296	1	1903	60,500.00	59,518.91	918.09
Soil investigations	do	32	297	1	1903	130,000.00	128,408.15	1,591.85
Entomological investigations	do	32	298	1	1903	37,500.00	37,485.44	14.56
Entomological investigations, 1902-3	do	32	298	1	1903	8,000.00	7,989.42	10.58
Biological investigations	do	32	298	1	1903	26,000.00	25,616.80	383.20
Biological investigations, 1902-3	do	32	298	1	1903	2,000.00	1,949.61	50.39
Urgent deficiency publications	do	32	1062	1	1903	200,000.00 4,000.00	190,961.49	13,038.51
Collecting agricultural statistics	do	32	300	1	1903	94,200.00	94,023.27	176.73
Agricultural experiment stations ($796,000 [a])	do	32	301	1	1903	76,000.00	77,552.69	333.31
Amount of deposits	do	32	301	1	1903	[b] 1,886.00		
Nutrition investigations	do	32	302	1	1903	20,000.00	19,901.12	98.88
Irrigation investigations	do	32	302	1	1903	65,000.00	62,201.12	2,798.88
Public road inquiries	do	32	302	1	1903	30,000.00	29,996.13	3.87
Foreign market investigations	do	32	300	1	1903	6,500.00	6,140.02	359.98
Silk investigations	do	32	303	1	1903	10,000.00	7,133.32	2,866.68
Expenses, Bureau of Animal Industry	do	32	289	1	1903	1,660,000.00	1,444,113.05	215,886.95
Urgent deficiency, Bureau of Animal Industry	do	32	1165	1	1903	500,000.00		
Weather Bureau:								
Salaries	do	32	286	1	1903	165,260.00	164,927.46	332.54
Fuel, lights, and repairs	do	32	287	1	1903	10,000.00	9,964.65	35.35
Contingent expenses	do	32	287	1	1903	8,000.00	7,806.38	193.62
General expenses	do	32	287	1	1903	915,000.00	428,219.24 480,377.71	1,280.76 5,622.29
Meteorological observation stations	do	32	288	1	1903	60,000.00	59,628.24	371.76
Buildings	do	32	288	1	1903	50,000.00	49,467.00	533.00
Cables and land lines	do	32	288	1	1903	40,000.00	40,000.00	....
Storm-warning stations, Glenhaven and South Manitou Island, Mich	do	32	288	1	1903	15,000.00	15,000.00	....
Salaries, Department of Agriculture, officers and clerks	Mar. 3, 1903	32	1147	1	1904	470,080.00	458,295.90	11,784.10
Salaries, extra laborers	do	32	1147	1	1904	1,000.00	982.01	17.99
Bureau of Animal Industry:								
General expenses, including $1,800 for rent of building	do	32	1150	1	1904	1,200,000.00	1,199,410.98	589.02
To eradicate contagious diseases of animals	do	......	......	......	......	250,000.00	249,868.64	131.06

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Receipts from sales of certain products of Alaska, Hawaii, and Porto Rico experiment stations.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Page.	Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Bureau of Plant Industry:								
Vegetable pathological investigations	Mar. 3, 1903	32	1152	1	1904	$122,000.00	$122,889.98	$0.06
Rent of building	do	32	1152	1	1904	3,000.00	2,109.96	
Vegetable pathological investigations, 1903–4	do	32	1152	1	1904	5,000.00	4,998.41	1.59
Pomological investigations	do	32	1153	1	1904	37,000.00	35,636.08	1,363.92
Botanical investigations and experiments	do	32	1153	1	1904	62,000.00	60,693.23	1,306.77
Rent of building	do	32	1153	1	1904	3,000.00	3,000.00	....
Grass and forage plant investigations	do	32	1154	1	1904	33,800.00	34,514.48	235.52
Rent of building	do	32	1154	1	1904	1,200.00	250.00	
Experimental gardens and grounds, Department of Agriculture	do	32	1154	1	1904	25,000.00	24,984.11	15.89
Arlington Experimental Farm	do	32	1155		1904	15,000.00	14,972.99	27.01
Tea-culture investigations	do	32	1155	1	1904	10,000.00	8,701.07	1,298.93
Purchase and distribution of valuable seeds	do	32	1155	1	1904	257,000.00	257,247.74	256.26
Foreign seed and plant introduction	do	32	1155	1	1904	30,000.00	27,483.93	2,012.07
Rent of building	do	32	1156	1	1904	3,000.00	....	3,000.00
Investigating production of domestic sugar	do	32	1156	1	1904	5,000.00	4,249.41	750.59
Bureau of Forestry:								
Forestry investigations, including $10,000 for rent of building	do	32	1156	1	1904	312,860.00	311,588.63	1,271.37
Protection of forest reserves[a]	do	.....	.....	.....	.....	16,864.01	341.12	16,522.89
Bureau of Chemistry:								
Laboratory, including $5,000 for table sirup	do	32	1157	1	1904	60,500.00	60,317.39	182.61
Laboratory, table sirup, 1903–4	do	32	1157	1	1904	10,000.00	9,898.89	101.11
Bureau of Soils, including $2,000 for rent of building	do	32	1159	1	1904	170,000.00	166,286.32	3,713.68
Entomological investigations	do	32	1160	1	1904	43,500.00	39,114.76	4,385.24
Silk investigations	do	32	1160	1	1904	10,000.00	9,055.31	944.69
Entomological investigations, 1903–4	do	32	1160	1	1904	12,000.00	11,825.82	174.18
Biological investigations, including $1,000 for care of game	do	32	1160	1	1904	34,000.00	33,066.92	933.08
Publications, Department of Agriculture, Farmers' Bulletins	do	32	1161	1	1904	105,000.00	104,997.90	2.10
Artists, etc	do	32	1161	1	1904	10,000.00	9,992.49	7.51
Labor, etc	do	32	1161	1	1904	85,000.00	84,746.73	253.27
Collecting agricultural statistics	do	32	1162	1	1904	104,200.00	103,225.90	974.10
Collecting agricultural statistics, 1903–4	do	32	1162	1	1904	5,000.00	4,996.84	3.16
Foreign-market investigations	do	32	1162	1	1904	7,500.00	7,455.40	44.60
Library, Department of Agriculture	do	32	1163	1	1904	10,000.00	9,972.93	27.07
Contingent expenses, Department of Agriculture	do	32	1163	1	1904	37,000.00	36,999.77	.23
Agricultural experiment stations ($810.000[b])	do	32	1163	1	1904	40,000.00	39,997.74	2.26
Stations of Alaska	do	32	1164	1	1904	15,000.00	15,000.00	....
Stations of Hawaii	do	32	1164	1	1904	15,000.00	15,000.00	....
Stations of Porto Rico	do	32	1164	1	1904	15,000.00	15,000.00	....
Farmers' institutes	do	32	1164	1	1904	5,000.00	4,838.69	161.31
Nutrition investigations	do	32	1164	1	1904	20,000.00	19,994.18	5.82
Irrigation investigations	do	32	1165	1	1904	65,000.00	64,938.65	61.35
Public road inquiries	do	32	1165	1	1904	32,000.00	31,813.00	187.00
Public road inquiries, 1903–4	do	32	1165	1	1904	3,000.00	3,000.00	....

[a] This appropriation and amount transferred from Department of Interior.

[b] Of this amount, $720,000 is paid directly to the experiment stations from the Treasury Department.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Page.	Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Weather Bureau:								
Salaries	Mar. 3, 1903	32	1148	1	1904	$175,440.00	$175,098.94	$341.06
Fuel, lights, and repairs	do	32	1148	1	1904	6,000.00	5,981.63	18.37
Contingent expenses	do	32	1148	1	1904	8,000.00	7,818.52	181.48
General expenses, salaries	do	32	1149	1	1904	472,300.00	471,917.22	382.78
General expenses, miscellaneous	do	32	1149	1	1904	496,780.00	494,741.03	2,038.97
Buildings	do	32	1149	1	1904	50,000.00	50,000.00	....
Cables and land lines	do	23	1149	1	1904	40,000.00	40,000.00	....
Salaries, officers and clerks	Apr. 23, 1904	33	276	1	1905	481,300.00	407,998.89	10,301.11
Salaries, extra laborers	do	33	277	1	1905	1,000.00	971.66	28.34
Bureau of Animal Industry:								
Deficiency appropriation	do	33	1242	1	1905	150,000.00	1,399,227.96	772.04
General expenses, including $1,800 for rent of building	do	33	279	1	1905	1,250,000.00		
Animal breeding and feeding	do	33	281	1	1905	25,000.00	20,540.67	4,459.33
To eradicate contagious diseases of animals, 1904–5[c]	do	33	5	1	1905	250,000.00	248,980.79	1,019.21
Bureau of Plant Industry:								
Vegetable pathological investigations	do	33	281	1	1905	145,000.00	145,705.01	....
Rent of building	do	33	281	1	1905	3,000.00	2,294.99	....
Vegetable pathological investigations, 1904–5	do	33	281	1	1905	2,000.00	2,000.00	....
Rent of quarters (deficiency)	do	33	603	1	1905	2,500.00	2,485.00	15.00
Pomological investigations[a]	do	33	282	1	1905	43,500.00	41,280.58	2,219.42
Botanical investigations and experiments	do	33	283	1	1905	64,500.00	63,914.24	585.76
Rent of building	do	33	283	1	1905	3,000.00	3,000.00	....
Grass and forage plant investigations	do	33	283	1	1905	40,500.00	40,012.04	487.96
Rent of building	do	33	283	1	1905	2,000.00	1,500.00	500.00
Experimental gardens and grounds, Department of Agriculture	do	33	284	1	1905	25,000.00	24,725.40	274.60
Greenhouses, Department of Agriculture, 1904–5	do	33	284	1	1905	25,000.00	24,995.32	4.68
Arlington Experimental Farm	do	33	284	1	1905	20,000.00	19,838.70	161.30
Tea-culture investigations	do	33	284	1	1905	10,000.00	8,387.15	1,612.85
Purchase and distribution of valuable seeds[b]	do	33	285	1	1905	242,500.00	240,379.71	2,120.29
Foreign seed and plant introduction[b]	do	33	286	1	1905	40,000.00	39,687.44	312.56
Repairs to building	do	33	285	1	1905	7,500.00	4,000.00	3,500.00
Investigating production of domestic sugar	do	33	286	1	1905	7,500.00	7,222.14	277.86
Bureau of Forestry:								
Forestry investigations, including $15,500 for rent of building	do	33	286	1	1905	388,000.00	386,618.32	1,381.68
Protection of Forest Reserves	do	33	286	1	1905	50,000.00	49,025.23	974.77
Testing timbers, Louisiana Purchase Exposition, St. Louis, Mo. (deficiency act)	do	33	1242	1	1905	10,000.00	9,985.82	14.18
Bureau of Chemistry:								
Laboratory, including $15,000 for table sirup	do	33	287	1	1905	105,000.00	103,693.95	1,306.05
Laboratory, 1904–5	do	33	288	1	1905	15,000.00	14,716.95	283.05
Laboratory road materials	do	33	288	1	1905	15,000.00	14,802.99	197.01
Bureau of Soils:								
Soil investigations, including $6,000 for rent of building	do	33	288	1	1905	170,000.00	168,638.84	1,361.16
Entomological investigations	do	33	289	1	1905	70,000.00	69,124.44	875.56
Cotton boll-weevil investigations, 1904–5[c]	do	33	5	1	1905	250,000.00	220,685.40	29,314.60

[a] By receipts from sale of fruits and vegetables (Pomological investigations) $2,426.21
[b] By transfer from foreign to domestic seeds 4,183.54
[c] By transfer from cotton boll weevil to Bureau of Animal Industry, 1904–5 .... 3,500.00

***Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.*—Continued.**

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Biological investigations	Apr. 23, 1904	33	290	1	1905	$33,000.00	$32,937.70	$62.30
Biological investigations, 1904-5, care of elk	do	33	291	1	1905	1,000.00	807.14	192.86
Publications, Department of Agriculture, Farmers' Bulletins	do	33	291	1	1905	105,000.00	104,885.16	114.84
Artists, etc	do	33	291	1	1905	15,000.00	14,635.28	364.72
Labor, etc	do	33	291	1	1905	89,000.00	88,985.64	14.36
Labor, etc., 1904-5	do	33	291	1	1905	1,000.00	430.64	569.36
Collecting agricultural statistics	do	33	292	1	1905	132,000.00	130,539.73	1,460.27
Foreign-market investigations	do	33	292	1	1905	7,500.00	6,069.72	1,430.28
Library, Department of Agriculture	do	33	293	1	1905	10,000.00	9,640.28	359.72
Contingent expenses, Department of Agriculture	do	33	293	1	1905	37,000.00	36,963.20	36.80
Agricultural experiment stations ($810,000[a])	do	33	293	1	1905	40,000.00	39,703.10	296.90
Stations of Alaska	do	33	294	1	1905	15,000.00	15,000.00	....
Stations of Hawaii	do	33	294	1	1905	15,000.00	15,000.00	....
Stations of Porto Rico	do	33	294	1	1905	15,000.00	15,000.00	....
Farmers' institutes	do	33	294	1	1905	5,000.00	4,603.53	396.47
Nutrition investigations	do	33	294	1	1905	20,000.00	19,976.98	23.02
Irrigation investigations	do	33	294	1	1906	67,500.00	67,416.35	83.65
Public road inquiries	do	33	295	1	1905	35,000.00	34,319.03	680.97
Building, Department of Agriculture	do	32	806	1	1905	250,000.00	108,496.32	141,503.68
Weather Bureau:								
Salaries	do	33	277	1	1905	180,440.00	180,225.57	214.43
Fuel, lights, and repairs	do	33	278	1	1905	8,000.00	7,979.20	20.80
Contingent expenses	do	33	278	1	1905	10,000.00	9,702.60	297.40
General expenses, salaries	do	33	278	1	1905	492,300.00	491,725.31	574.69
General expenses, miscellaneous	do	33	279	1	1905	572,000.00	569,424.01	2,575.99
Buildings	do	33	279	1	1905	48,000.00	47,803.11	196.89
Cables and land lines	do	33	279	1	1905	27,000.00	26,991.09	8.91
Salaries, officers and clerks	Mar. 3, 1905	33	861	1	1906	804,970.00	783,042.64	21,927.36
Salaries, extra labor	do	33	861	1	1906	10,000.00	9,120.34	879.66
Bureau of Animal Industry:								
Deficiency act	Feb. 27, 1906	......	......	...	1906	....	....	....
General expenses (including $63,000 deficiency)	Mar. 3, 1905	33	864	1	1906	1,492,020.00	1,405,951.28	86,068.72
Animal breeding and feeding	do	33	866	1	1906	25,000.00	24,429.56	570.44
Rent of buildings	do	33	865	1	1906	2,500.00	1,802.00	698.00
Bureau of Plant Industry:								
Vegetable pathological investigations	do	33	867	1	1906	139,640.00	135,320.51	4,319.49
Rent of building	do	33	867	1	1906	6,000.00	3,720.00	2,280.00
Vegetable pathological investigations, 1905-6	do	33	868	1	1906	10,000.00	9,560.46	439.54
Grain investigations	do	33	868	1	1906	25,000.00	23,843.68	1,156.32
Pomological investigations	do	33	868	1	1906	33,640.00	33,639.62	.38
Rent of building	do	33	868	1	1906	2,000.00	2,000.00	....
Botanical investigations and experiments	do	33	869	1	1906	60,840.00	59,338.60	1,501.40
Rent of building	do	33	869	1	1906	3,000.00	3,000.00	....
Grass and forage plant investigations	do	33	869	1	1906	37,160.00	33,279.00	3,881.00
Rent of building	do	33	869	1	1906	2,500.00	2,490.00	10.00
Experimental gardens and grounds	do	33	870	1	1906	15,320.00	15,273.75	46.25
Experimental gardens and grounds, 1905-6	do	33	870	1	1906	5,000.00	4,978.00	22.00
Arlington experimental farm	do	33	870	1	1906	20,000.00	19,667.35	332.65
Tea-culture investigations	do	33	870	1	1906	8,500.00	7,944.83	555.17
Purchase and distribution of valuable seeds	do	33	870	1	1906	205,140.00	202,767.39	2,372.61
Foreign seed and plant introduction	do	33	871	1	1906	37,780.00	32,429.83	5,350.17
Investigating production of domestic sugar	do	33	872	1	1906	7,500.00	7,317.54	182.46

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forest Service:								
General expenses, Forest Service	Mar. 3, 1905	33	872	1	1906	$768,180.00	$767,722.04	$457.96
Rent of buildings	do	33	873	1	1906	25,000.00	25,000.00	....
Bureau of Chemistry:								
Laboratory, including $3,000 for table sirup	do	33	873	1	1906	130,920.00	128,289.99	2,630.01
Bureau of Soils:								
Soil investigations, including $4,000 for rent of building	do	33	875	1	1906	170,000.00	167,403.73	2,596.27
Bureau of Entomology:								
Entomological investigations, including $2,500 for moth investigations	do	33	876	1	1906	68,060.00	65,457.52	2,602.48
Bureau of Biological Survey:								
Biological investigations	do	33	877	1	1906	44,420.00	44,064.71	355.29
Division of Publications:								
Publications, Department of Agriculture, Farmers' Bulletins	do	33	878	1	1906	98,750.00	98,601.49	148.51
Artists, etc	do	33	878	1	1906	3,500.00	3,434.10	65.90
Labor, etc	do	33	879	1	1906	30,000.00	29,767.04	232.96
Bureau of Statistics:								
Collecting agricultural statistics	do	33	879	1	1906	93,900.00	90,007.12	3,892.88
Foreign market investigations	do	33	879	1	1906	4,900.00	4,720.13	179.87
Library, Department of Agriculture	do	33	880	1	1906	8,040.00	7,411.73	628.27
Contingent expenses, Department of Agriculture	do	33	880	1	1906	35,000.00	34,878.55	121.45
Contingent expenses, 1905–6	do	33	880	1	1906	2,000.00	2,000.00	....
Agricultural experiment stations ($1,034,660) [a]	do	33	881	1	1906	21,660.00	20,908.90	751.10
Stations of Alaska, including $3,000 for purchase of live stock	do	33	881	1	1906	18,000.00	18,000.00	....
Stations of Hawaii	do	33	881	1	1906	15,000.00	15,000.00	....
Stations of Porto Rico	do	33	881	1	1906	15,000.00	15,000.00	....
Farmers' institutes	do	33	882	1	1906	5,000.00	4,550.52	449.48
Nutrition investigations	do	33	882	1	1906	20,000.60	19,805.11	194.89
Irrigation investigations	do	33	882	1	1906	74,200.00	74,044.61	155.39
Public-road inquiries	do	33	882	1	1906	37,660.00	36,479.77	1,180.23
Cotton-boll weevil investigations	do	33	883	1	1906	190,000.00	154,671.59	35,328.41
Weather Bureau:								
Salaries	do	33	862	1	1906	191,430.00	190,930.72	499.28
Fuel, lights, and repairs	do	33	862	1	1906	10,000.00	9,926.33	73.67
Contingent expenses	do	33	863	1	1906	10,000.00	9,841.53	158.47
Salaries, station employees	do	33	863	1	1906	531,550.00	530,662.89	887.11
General expenses	do	33	863	1	1906	562,010.00	553,143.78	8,866.22
Buildings	do	33	863	1	1906	53,000.00	52,748.43	251.57
Cables and land lines	do	33	864	1	1906	35,000.00	34,121.31	878.69
Salaries, officers and clerks	June 30, 1906	34	670	1	1907	750,170.00	730,481.65	19,688.35
Salaries, extra labor	do	34	670	1	1907	7,600.00	6,355.73	1,244.27
Contingent expenses	do	34	692	1	1907	37,000.00	33,014.40	3.985.60
Library	do	34	691	1	1907	10,000.00	8,046.96	1,953.04
Bureau of Animal Industry:								
General expenses	do	34	673	1	1907	809,700.00	621,918.25	187,781.75
Rent of buildings	do	34	673	1	1907	2,500.00	2,118.50	381.50
Southern dairy work	do	34	674	1	1907	20,000.00	15,647.09	4,352.91
Diseases of domestic animals, Minnesota	do	34	674	1	1907	5,000.00	1,480.33	3,519.67
Animal breeding and feeding	do	34	674	1	1907	25,000.00	18,127.92	6,872.08
Meat inspection	do	34	674	1	1907	3,000,000.00	1,932,208.19	1,067,791.81
Eradicating cattle ticks:								
1907	do	34	696	1	1907	82,500.00	80,579.29	1,920.71
1907 and 1908	Mar. 4, 1907	34	1281	1	1907	25,000.00	14,188.10	10,811.90

[a] Of this amount $960,000 was paid directly to the experiment stations from the Treasury Department.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Plant Industry:								
General expenses	June 30, 1906	34	680	1	1907	$480,406.28	$423,760.07	$56,646.21
Rent and repairs	do	34	681	1	1907	11,300.00	10,106.75	1,193.25
Ozark Mountain investigations	do	34	681	1	1907	3,553.72	3,330.49	223.23
Grain investigations	do	34	681	1	1907	15,000.00	13,582.80	1,417.20
Improving roads	do	34	681	1	1907	3,500.00	3,472.00	28.00
Purchase and distribution of valuable seeds	do	34	682	1	1807	205,140.00	180,871.16	24,268.84
Foreign seed and plant introduction	do	34	682	1	1907	35,780.00	27,249.80	8,530.20
Erection of building at Chico, Cal	do	34	683	1	1907	2,000.00	2,000.00	....
Cotton boll weevil investigations:								
1907	do	34	695	1	1907	105,000.00	91,545.68	13,454.32
1907 and 1908	Mar. 4, 1907	34	1280	1	1907	40,000.00	4,367.58	35,632.42
Bureau of Chemistry:								
Laboratory	June 30, 1906	34	685	1	1907	145,920.00	131,530.41	14,389.59
Enforcement of the food and drugs act	Dec. 19, 1906	34	841	1	1907	250,000.00	36,217.41	213,782.59
Bureau of Soils:								
Soils investigations	June 30, 1906	34	687	1	1907	181,000.00	168,651.81	12,348.19
Rent of buildings	do	34	687	1	1907	4,000.00	3,483.33	516.67
Bureau of Entomology:								
Entomological investigations	do	34	688	1	1907	70,000.00	65,147.09	4,852.91
White fly investigations	do	34	688	1	1907	5,000.00	4,538.24	461.76
Cotton boll weevil investigations	do	34	695	1	1907	85,000.00	58,598.72	26,401.28
Preventing spread of moths:								
1907	do	34	696	1	1907	82,500.00	80,309.35	2,190.65
1907 and 1908	Mar. 4, 1907	34	1281	1	1907	150,000.00	8,592.73	141,407.27
Bureau of Biological Survey:								
Biological investigations	June 30, 1906	34	688	1	1907	44,420.00	40,844.51	3,575.49
Division of Publications:								
Publications, Farmers' Bulletins	do	34	690	1	1907	98,750.00	91,175.67	7,574.33
Artists, etc	do	34	690	1	1907	3,500.00	3,224.80	275.20
Labor, etc	do	34	690	1	1907	30,000.00	27,546.27	2,453.73
Bureau of Statistics:								
Collecting agricultural statistics	do	34	691	1	1907	108,000.00	86,756.05	21,243.95
Foreign markets investigations	do	34	691	1	1907	4,900.00	4,852.95	47.05
Office of Experiment Stations:								
Agricultural experiment stations ($803,500 [a])	do	34	693	1	1907	25,500.00	24,467.75	1,032.25
Farmers' institutes	do	34	693	1	1907	5,000.00	4,105.95	894.05
Station at Alaska, including $3,000 for purchase of live stock	do	34	693	1	1907	18,000.00	17,968.89	31.11
Station at Hawaii, including $5,000 for water supply	do	34	693	1	1907	20,000.00	20,000.00	....
Station at Porto Rico	do	34	693	1	1907	15,000.00	15,000.00	....
Nutrition investigations	do	34	694	1	1907	20,000.00	16,637.32	3,362.68
Irrigation investigations	do	34	694	1	1907	122,200.00	103,002.80	19,197.20
Office of Public Roads: Public road inquiries	do	34	694	1	1907	57,660.00	49,975.45	7,684.55
Weather Bureau:								
Salaries	do	34	671	1	1907	194,690.00	193,918.11	771.89
Fuel, lights, and repairs	do	34	671	1	1907	10,000.00	9,356.14	643.86
Contingent expenses	do	34	671	1	1907	10,000.00	8,915.70	1,084.30
Salaries, station employees	do	34	672	1	1907	541,550.00	497,110.47	44,439.53
General expenses	do	34	672	1	1907	630,000.00	425,736.18	204,263.82
Buildings	do	34	672	1	1907	53,000.00	24,158.31	28,841.69

[a] This includes $720,000 for State experiment stations paid through the Treasury Department. Congress also appropriated $336,000 for State experiment stations under the Adams bill to be paid through the Treasury Department. Total paid through the Treasury Department for State experiment stations, $1,066,000. Congress also appropriated in the sundry civil bill for printing and binding $300,000.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forest Service:								
Salaries, officers and clerks	June 30, 1906	34	683	1	1907	$112,860.00	$102,826.06	$10,033.94
General expenses	do	34	683	1	1907	849,640.00	641,033.95	208,606.05
Rent	do	34	685	1	1907	35,000.00	20,266.62	14,733.38
Building on Dismal River Forest Reserve	do	34	696	1	1907	2,500.00	2,475.22	24.78
Wichita Forest and Game Preserve	do	34	696	1	1907	15,000.00		15,000.00
Survey and report on Appalachian and White Mountain watersheds, 1907 and 1908	Mar. 4, 1907	34	1281	1	1907	25,000.00	857.14	24,142.86
Administration, etc., of the National Forests, 1907 and 1908	do	34	1270	1	1907	125,000.00	6,213.21	118,786.79
Special appropriations:								
Pomological investigations, fund from sale of fruits and vegetables	Apr. 23, 1904	33	382	1	1905	3,541.28	1,761.88	1,779.40
Agricultural experiment stations, fund from sale of card indexes	do	33	293	1	1905	65.15		65.15
Buildings, Department of Agriculture	Mar. 3, 1903 Mar. 3, 1905	32 33	1139 1211			250,000.00 700,000.00		
Balance available July 1, 1906						480,934.68		
Sundry civil act	June 30, 1906	34	758			300,000.00	535,594.61	245,340.07
Administration, etc., forest reserves						925,000.00	812,293.34	112,706.66
Cooperative work, forest investigations						21,410.25	16,612.05	4,798.20
Salaries, officers and clerks	Mar. 4, 1907	34	1256	1	1908	825,890.00	771,881.43	54,008.57
Salaries, extra labor	do	34	1256	1	1908	7,600.00	7,184.94	415.06
Contingent expenses	do	34	1277	1	1908	47,000.00	39,860.67	7,139.33
Library	do	34	1277	1	1908	12,500.00	10,745.32	1,754.68
Bureau of Animal Industry:								
General expenses	do	34	1259	1	1908	892,200.00	774,562.84	117,637.16
Diseases of domestic animals, Minnesota	do	34	1259	1	1908	5,000.00	2,766.65	2,233.35
Animal breeding and feeding	do	34	1260	1	1908	50,000.00	46,840.81	3,159.19
Meat inspection	June 30, 1906	34	674	1	1908	3,000,000.00	2,481,539.40	518,460.60
Eradicating cattle ticks:								
1908	Mar. 4, 1907	34	1281	1	1908	125,000.00	112,282.59	12,717.41
1907 and 1908 (appropriated $25,000; balance July 1, 1907)	do	34	1281	1	1908	10,811.90	10,811.90	Exhausted.
Bureau of Plant Industry:								
General expenses	do	34	1266	1	1908	573,480.00	500,282.55	73,197.45
Rent and repairs	do	34	1267	1	1908	11,300.00	8,830.75	2,469.25
Grain investigations	do	34	1267	1	1908	40,000.00	33,106.15	6,893.85
Purchase and distribution of valuable seeds (includes $50,000, deficiency act)	do	34	1267	1	1908	252,000.00	235,648.84	16,351.16
Foreign seed and plant introduction	do	34	1267	1	1908	36,000.00	26,006.49	9,993.51
Cotton boll weevil investigations:								
1908	do	34	1280	1	1908	110,000.00	95,607.35	14,392.65
1907 and 1908 (appropriated $40,000; balance July 1, 1907)	do	34	1280	1	1908	35,632.42	32,458.62	3,173.80
Bureau of Chemistry: Laboratory	do	34	1271	1	1908	650,000.00	467,654.99	182,345.01
Bureau of Soils:								
Soil investigations	do	34	1272	1	1908	166,000.00	146,905.64	19,094.36
Rent of buildings	do	34	1273	1	1908	4,000.00	3,156.66	843.34
Bureau of Entomology:								
Entomological investigations	do	34	1273	1	1908	103,800.00	90,923.05	12,876.95
White fly investigations	do	34	1274	1	1908	10,000.00	8,576.50	1,423.50
Cotton boll weevil investigations	do	34	1280	1	1908	40,000.00	34,592.99	5,407.01
Preventing spread of moths 1907 and 1908 (appropriated $150,000; balance July 1, 1907)	do	34	1280	1	1908	141,407.27	122,857.32	18,549.95

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Biological Survey:								
Biological investigations	Mar. 4, 1907	34	1274	1	1908	$44,420.00	$39,629.92	$4,790.08
Division of Publications: Publications [a]	do	34	1275	1	1908	35,000.00	32,889.67	2,110.33
Bureau of Statistics:								
Collecting agricultural statistics	do	34	1276	1	1908	118,000.00	96,344.56	21,655.44
Foreign markets investigations	do	34	1276	1	1908	4,000.00	4,338.62	561.38
Office of Experiment Stations:								
Agricultural experiment stations ($827,000) [b]	do	34	1278	1	1908	30,000.00	26,471.55	3,528.45
Farmers' institutes	do	34	1279	1	1908	5,000.00	4,348.68	651.32
Station at Alaska	do	34	1278	1	1908	24,000.00	24,000.00	(c)
Station at Hawaii	do	34	1278	1	1908	24,000.00	24,000.00	(c)
Station at Porto Rico	do	34	1278	1	1908	24,000.00	24,000.00	(c)
Nutrition investigations	do	34	1279	1	1908	5,000.00	1,593.00	3,407.00
Irrigation investigations	do	34	1279	1	1908	150,000.00	115,164.28	34,835.72
Office of Public Roads:								
Public road inquiries	do	34	1280	1	1908	55,660.00	48,930.52	6,729.48
Rent and repairs	do	34	1280	1	1908	2,000.00	1,723.27	276.73
Weather Bureau:								
Salaries	do	34	1257	1	1908	196,990.00	187,983.40	9,006.60
Fuel, lights, and repairs	do	34	1258	1	1908	10,000.00	7,143.66	2,856.34
Contingent expenses	do	34	1258	1	1908	10,000.00	8,032.53	1,967.47
Salaries, station employees	do	34	1258	1	1908	551,550.00	505,765.11	45,784.89
General expenses	do	34	1258	1	1908	645,000.00	411,441.43	233,558.57
Forest Service:								
Salaries, officers and clerks	do	34	1269	1	1908	143,200.00	130,031.93	13,168.07
General expenses	do	34	1269	1	1908	1,696,800.00	1,519,591.85	177,208.15
Rent (joint resolution, Jan. 7, 1908, increasing rent)	do	34	1270	1	1908	60,000.00	43,010.88	16,989.12
Administration, etc., of National Forests, 1908	do	34	1270	1	1908	375,000.00	291,353.63	83,646.37
Survey and report on Appalachian and White Mountain watersheds, 1907 and 1908 (appropriated $25,000; balance July 1, 1907)	do	34	1281	1	1908	23,403.76	15,272.33	8,131.43
Administration, etc., of National Forests, 1907 and 1908 (appropriated $125,000; balance July 1, 1907)	do	34	1270	1	1908	118,786.79	109,149.79	9,637.00
Special appropriations:								
Pomological investigations, fund from sale of fruits and vegetables, balance July 1, 1907	Apr. 23, 1904	33	382	1	......	1,779.40	1,011.28	768.12
Agricultural experiment stations, fund from sale of card indexes, balance July 1, 1907	Mar. 4, 1907	34	1278	1	......	65.15	65.15	(c)
Administration, etc., forest reserves ($2,401,328.97, balance July 1, 1907)						1,172,922.36	988,318.93	184,603.43
Cooperative work, forest investigations						28,979.97	21,073.79	7,906.18
Buildings, Department of Agriculture ($1,250,000):								
Balance available July 1, 1907	Mar. 3, 1903	32	1139	...	......	245,340.07	465,045.74	30,294.33
Sundry civil act, Mar. 4, 1907	Mar. 3, 1905	33	1211	...	......	250,000.00		

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[a] Congress also appropriated, in the sundry civil bill, for printing and binding $433,750.

[b] This includes $720,000 for State experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $432,000 as a permanent appropriation for State experiment stations under the Adams bill, to be paid through the Treasury Department. Total to be paid through the Treasury Department for State experiment stations, $1,152,000.

[c] Exhausted.

For the years 1907 and 1908 the figures represent payments made to close of June 30, 1907, the accounts for those years being still open at the date of this revision.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

RECAPITULATION.

Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
1839...	$1,000.00	$1,000.00	....	1875..	$337,380.00	$321,079.83	$16,300.17
1840...	....	....	....	1876..	249,120.00	198.843.64	50,276.36
1841...	....	....	....	1877..	194,686.96	188,206.19	6,480.77
1842...	1,000.00	1,000.00	....	1878..	198,640.00	197,634.94	1,005.06
1843...	....	....	....	1879..	206,400.00	206,360.00	40.00
1844...	2,000.00	2,000.00	....	1880..	199,500.00	198,361.72	1,138.28
1845...	2,000.00	2,000.00	....	1881..	275,460.31	267,608.84	[b] 7,851.47
1846...	3,000.00	3,000.00	....	1882..	363,011.05	354,482.39	[c] 8,528.66
1847...	3,000.00	3,000.00	....	1883..	456,396.11	438,941.72	[d] 17,454.39
1848...	4,500.00	4,500.00	....	1884..	[a] 416,641.13	413,618.09	3,023.04
1849...	3,500.00	3,500.00	....	1885..	[a] 655,930.25	558,934.89	[e] 96,995.36
1850...	5,500.00	5,500.00	....	1886..	[a] 677,973.22	519,196.11	158,777.11
1851...	5,500.00	5,500.00	....	1887..	[a] 657,641.81	628,287.14	29,354.67
1852...	5,000.00	5,000.00	....	1888 [f]	1,027,219.06	1,011,282.62	15,936.44
1853...	5,000.00	5,000.00	....	1889..	[a] 1,134,480.60	1,033,590.22	[g] 100,890.38
1854...	10,000.00	10,000.00	....	1890..	[a] 1,170,139.11	971,823.62	[h] 198,315.49
1855...	[a] 50,000.00	50,000.00	....	1891..	[a] 1,372,049.21	1,266.277.36	105,771.85
1856...	30,000.00	30,000.00	....	1892..	[a] 2,303,655.75	2,253,262.29	50,393.46
1857...	75,000.00	75,000.00	....	1893..	2,540,060.72	2,355,430.25	184,630.47
1858...	63,500.00	63,157.25	$342.75	1894..	2,603,855.58	1,977,469.28	[i] 626,386.30
1859...	60,000.00	60,000.00	....	1895..	[i] 2,506,915.00	2,021,030.38	485,884.62
1860...	40,000.00	40,000.00	....	1896..	2,584,013.22	2,094,916.42	489,096.80
1861...	60,000.00	60,000.00	....	1897..	2,448,763.53	2,348,512.98	100,250.55
1862...	64,000.00	63,704.21	295.79	1898..	2,467,902.00	2,425,510.44	42,391.56
1863...	80,000.00	80,000.00	....	1899..	2,829,702.00	2,827,795.65	28,899.27
1864...	199,770.00	189,270.00	10,500.00	1900..	3,006,022.00	2,947,603.42	58,418.58
1865...	112,304.05	112,196.55	107.50	1901..	3,304,265.97	3,239,137.39	65,128.58
1866...	167,787.82	167,787.82	....	1902..	3,922,780.51	3,902,675.79	20,104.72
1867...	199,100.00	199,100.00	....	1903..	5,015,846.00	4,734,230.84	281,615.16
1868...	279,020.00	277,094.34	1,925.66	1904..	5,025,024.01	4,969,311.64	55,712.37
1869...	172,593.00	172,593.00	....	1905..	5,894,540.00	5,820,204.00	74,336.00
1870...	156,440.00	151,596.93	4,843.07	1906..	6,225,690.00	6,029,510.02	196,179.98
1871...	[a] 188,180.00	186,876.81	1,303.19	1907 [j]	11,557,691.36	8,586,209.23	2,971,482.13
1872...	197,070.00	195,977.25	1,092.75	1908 [j]	13,201,419.09	11,212,809.95	1,988,609.14
1873...	202,440.00	201,321.22	1,118.78				
1874...	257,690.00	233,765.78	23,924.22	Total	[k] 89,047,501.94	[l] 79,877,401.91	[m] 9,255,870.77

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[a] Including deficiency appropriation.

[b] Includes $1,646.45 of the appropriation for reclamation of arid lands, carried to the fiscal year 1882.

[c] Includes $85.26 of the appropriation for reclamation of arid lands and $3,530.85 of the appropriation for experiments in the manufacture of sugar, carried to the fiscal year 1883.

[d] Includes $7,656.13 of the appropriation for reclamation of arid lands, carried to the fiscal year 1884.

[e] Includes $93,192.27 of the appropriation for Bureau of Animal Industry and $2,970.82 of the appropriation for quarantine stations, carried to the fiscal year 1886.

[f] For the fiscal year 1888, including the sum of $8,000 appropriated for deficiencies in the appropriation for experiments in the manufacture of sugar for the fiscal years 1887 and 1888, of which $7,927.50 was disbursed and $72.50 remained unexpended.

[g] Includes $12,923.25 of the appropriation for botanical investigations and $58,364.76 of the appropriation for experiments in the manufacture of sugar, carried to the fiscal year 1890.

[h] Includes $188,974.69 of the appropriation for Bureau of Animal Industry, carried to the fiscal year 1891.

[i] Includes $7,891.94 for statutory salaries of the year 1894.

[j] For the years 1907 and 1908 the figures given represent payments made to close of June 30, 1908, the accounts for those years being still open at the date of this revision.

[k] This total is the amount actually appropriated for the various fiscal years, with the exception of $37,604.70 appropriated July 13, 1868, to cover a number of expenditures made in previous years. It does not include an aggregate sum of $369,344.48 reappropriated from the unexpended balances of several fiscal years. (See foregoing notes.)

[l] Does not include $37 604.70 which was disbursed during several years, and covered by an appropriation of like amount, made July 13, 1868. (See note *k*.)

[m] Does not include an aggregate sum of $369,344.48 reappropriated from the unexpended balances of several fiscal years. (See foregoing notes.)

REPORT OF THE EDITOR.

United States Department of Agriculture,
Division of Publications,
Washington, D. C., October 22, 1908.

Sir: I have the honor to submit herewith for your information and consideration a report of the work of this Division for the fiscal year ended June 30, 1908, together with certain recommendations in regard to future appropriations.

Respectfully,
Geo. Wm. Hill,
Editor and Chief.

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE YEAR.

SUMMARY OF RESULTS.

During the year 1908 1,522 publications were issued, comprising 58,510 printed pages, of which 447 were new, 998 were reprints, and 77 were publications of the Weather Bureau, the total editions of all publications aggregating 16,875,516 copies. In 1907 the total number of publications issued was 1,415, comprising 52,363 printed pages, and the total number of copies was 16,746,910, the increase during the year 1908 being 128,606 copies. The number of requisitions issued upon the Government Printing Office in 1908 was 7,314, of which 2,739 were on the main office and 4,575 were on the branch office. In 1907 the number of requisitions for printing and binding issued was 7,207, of which 2,762 were on the main office and 4,445 were on the branch office. These figures are exclusive of the work done for and at the Weather Bureau.

The details of the work of the Division during the year are shown in the tables appearing at the end of this report.

FARMERS' BULLETINS.

The appropriation for printing Farmers' Bulletins for the year was $98,750, with which amount it was estimated that 6,000,000 copies of Farmers' Bulletins could be issued, and under the law allotting four-fifths of these bulletins to Senators, Representatives, and Delegates 10,000 copies were assigned to each, and also to the Vice-President, the Secretary and the Sergeant-at-Arms of the Senate, and the Clerk and Sergeant-at-Arms of the House, amounting in all to 4,930,000 copies. As the first editions of the 26 new Farmers' Bulletins aggregated but 560,000 copies, the funds were sufficient to print

6,014,500 copies of reprints of these and earlier Farmers' Bulletins, making a total of 6,574,500 copies secured from the appropriation. There were on hand at the beginning of the fiscal year subject to the Secretary's disposal 1,398,102 copies of Farmers' Bulletins, making a total of Farmers' Bulletins available for distribution during the year 7,972,602 copies.

Although the allotment to Senators, Representatives, and Delegates amounted to nearly 5,000,000 copies, only 3,928,437 copies were actually distributed by them, leaving to their credit under the present appropriation printing bill slightly more than 1,000,000 copies, which were carried over on the books of the department subject to the orders of those who had drawn no Farmers' Bulletins or who had not disposed of their entire quotas.

The Secretary's one-fifth of the Farmers' Bulletins actually printed during the year amounted to 1,314,900 copies, and there remained at his disposal from the previous year 1,398,102, or a total of 2,713,002 copies. A reference to the records of miscellaneous distribution shows that there were distributed to persons applying direct to the Department, to crop and weather correspondents, and to other collaborators of the Department, 2,758,582 copies of Farmers' Bulletins.

The demand for Farmers' Bulletins continues to increase, particularly from educational institutions; but owing to the change in the printing law, there is no residue to revert to the Secretary from those not distributed by Senators, Representatives, and Delegates, and, therefore, for the current fiscal year he has, under the law, only one-fifth of the bulletins which may be provided from the appropriation of $125,000 borne on the printing bill for the year ending June 30, 1909. As the estimated number of copies of Farmers' Bulletins which can be so provided is about 8,000,000, the Secretary's quota will amount to not more than 1,600,000, or over 1,000,000 less than the number distributed upon his orders during the past year, and the allotment of 12,500 each to Senators, Representatives, and Delegates will practically exhaust the other four-fifths. It is, therefore, evident that there will be no supply from which additional copies can be allotted by the Secretary to Senators, Representatives, and Delegates who find themselves in need of additional bulletins, and that it will be necessary to refer such applicants to their colleagues in the Senate and House, many of whom, the records of the Department show, are not in the habit of distributing their entire quotas.

The records of distribution for many years past demonstrate that the Department needs and can make excellent use of a much larger number of Farmers' Bulletins than its customary allotment affords. Heretofore the provision of law under which all unused residues of congressional quotas reverted to the Secretary on a certain date has supplied the Department with the additional copies needed, and at the same time has prevented the accumulation of these unused quotas from becoming a burden on the storage capacity of the Department. The most important phase of the matter, however, is that the people of the United States are entitled to the information which these bulletins contain, and that any policy which tends to indefinitely hold them out of circulation is manifestly detrimental to public interest.

SALE OF DEPARTMENT PUBLICATIONS.

Miscellaneous applicants for publications of a scientific or technical character, the editions of which are necessarily limited, are continually being referred, under General Order 96, to the Superintendent of Documents, the official designated by law to sell government publications.

During the year ended June 30, 1908, this official sold 94,626 copies of the publications of this Department, for which he received $14,174.22. During the same period he sold only 61,692 copies of the publications of all the other executive departments, receiving therefor $35,945.89. It will be seen that the Superintendent of Documents sold of the publications of this Department nearly 33,000 more copies than the total number sold of the publications of all the other departments. The difference in the amount received is doubtless due to the fact that the publications of the other departments are, on an average, larger and more expensive.

The Superintendent of Documents is availing himself more frequently of the provision of the law of March 28, 1904, under which he may reprint, with the approval of the Secretary of Agriculture, the publications for which there is a demand, without any expense to the Department. It is believed that there is a growing willingness on the part of the public to pay the nominal price charged for our publications when the same can not be procured from the Department. The wisdom of the policy of referring miscellaneous applicants to the Superintendent of Documents would therefore seem to be demonstrated. Moreover, it is the only alternative unless the allotment for printing be very greatly increased.

METHOD OF DISTRIBUTING PUBLICATIONS.

As there seems to be some misunderstanding in regard to the method of distributing the Department publications, a restatement of the established method is in order. Under the law of January 12, 1895, the Secretary designated the Chief of the Division of Publications to have supervision of the distribution of all the publications of this Department, and he is required to prevent duplication and to report annually thereon. It is obvious that unless the distribution be centralized, duplication can not be prevented; neither can an accurate account be kept nor a satisfactory report be made. In order, therefore, to make the law effective by centralizing the distribution in this Division, on January 28, 1898, the Secretary notified all chiefs of bureaus, divisions, and offices to discontinue the miscellaneous mailing of publications and to make orders on this Division for the mailing of all documents. In the scheme of proposed distribution prepared at the time a manuscript is submitted for publication, provision is made for furnishing to the bureau, division, or office submitting the same a certain number of copies, usually 100, for office use; but for all distribution, including the regular lists, orders must be sent to the Division of Publications on the regular form, printed copies of which are furnished. Addressed franks or envelopes should always be furnished with orders for mailing to any considerable number of names and addresses, particularly in case of the regular bureau lists, unless they are on stencils in the document section. The carrying out of the scheme of distribution should follow immediately upon the receipt of the publication from the printer.

DISCONTINUANCE OF PLATE ILLUSTRATIONS.

It is believed that in the interest of economy the practice of using half-tone full-page plate illustrations should be discontinued, and that such half tones as are used should be made text figures. This would obviate the use of the heavy-coated plate paper which is not durable, as well as the expense of tipping in the plates when printed. This is an item of considerable importance where the number of plates is large, as in the Yearbook. Should this course be followed, a better quality of book paper will be required than is now used, preferably better paper than the Government Printing Office is at present prepared to supply, but which it could doubtless procure. The practice of printing the illustrations separately on paper of a different quality and afterwards inserting them in the publications has been abandoned by the leading publishers of this and foreign countries, because better results are secured by printing all the illustrations in the text, and a considerable saving in cost is thereby effected. The advisory committee on printing and publication work has recommended the adoption of this plan, and it is now being applied to new publications as rapidly as possible.

AVAILABILITY OF ELECTROTYPE PLATES OF DEPARTMENT PUBLICATIONS FOR AGRICULTURAL EXPERIMENT STATIONS.

For several years efforts have been made to effect some arrangement whereby the State agricultural experiment stations could secure at reasonable cost electrotype plates of such publications of the Department as they desired to republish and distribute. The provision under which the Public Printer is authorized to sell electrotype plates is contained in section 52 of the law of January 12, 1895, and is as follows:

> The Public Printer shall sell, under such regulations as the Joint Committee on Printing may prescribe, to any person or persons who may apply, additional or duplicate stereotype or electrotype plates from which any government publication is printed, at a price not to exceed the cost of composition, the metal and making to the Government and ten per centum added: *Provided*, That the full amount of the price shall be paid when the order is filed: *And provided further*, That no publication reprinted from such stereotype or electrotype plates and no government publication shall be copyrighted.

Under this law the cost is practically prohibitive, and persons desiring to reprint our publications find it cheaper to have the work done by private firms; but even this involves more expense than the experiment stations wish to incur. Recently, however, the matter has been brought to the attention of the Public Printer, and he has decided that the agricultural experiment stations, being maintained in part at least by Federal appropriations, may obtain from him electrotype plates of government publications without paying for the cost of the composition, the only charge to them being 66 cents per page for the electrotyping. With the plates procured in this way the stations can reprint any publication of the Department and supplement the distribution made by the Department, which is often restricted on account of insufficient funds for printing. Doubtless many of the stations will avail themselves of this arrangement, the results of which will be of great benefit to the Department, the stations themselves, and the people generally for whose information and instruction the publications are printed. It is suggested that when reprints are thus made, the fact should be so stated, preferably on the title-page.

While gratification is expressed at the opportunity now afforded to the experiment stations to reprint and distribute the Department publications under more favorable conditions, it is hoped that eventually the same consideration may be given the orders received through the secretaries of state of the various States. The probabilities are that such an arrangement would result in the receipt by the Public Printer of numerous orders for electrotypes from such officials, who, in turn, would print and distribute such number of copies as might be required for their educational institutions, teachers, etc. The demand for publications from colleges, schools, and educational institutions generally is now greater than the Department is able to supply, and if the wider distribution mentioned is desired and encouraged, some modification of the law will probably be necessary. It is submitted that this is a matter that should be brought to the attention of Congress.

ANNUAL REPORTS REQUIRED BY LAW.

The following is a list of the annual reports of this Department, the printing of which is specifically provided for by law. The total number of copies authorized, the number of copies ordered for the use of the Department, and the average cost thereof are shown:

Annual reports provided for by law.

Title of publication.	Copies authorized.	Copies ordered for Department.	Cost to Department.
Yearbook	300,000	30,000	$17,700.00
Annual Reports of the Department of Agriculture	6,000	1,500	2,759.78
Report of Chief of Weather Bureau	4,000	1,000	5,000.00
Report of the Bureau of Animal Industry	30,000	5,000	4,400.00
Report of the Office of Experiment Stations	8,000	3,000	2,266.50
Report on Progress of the Beet-Sugar Industry	8,000	5,000	459.85
Field Operations of the Bureau of Soils	6,000	1,000	11,961.47

The first cost of the reports above enumerated is, under the provisions of public resolution 13, approved March 30, 1906, charged against the allotment for printing and binding for the Department. This charge involves the cost of composition, stereotyping, and illustrations, and the cost of paper for the number of copies ordered by the Department and the printing and binding of the same. The estimated cost, approximately $45,000, is, under the law, set aside by the Public Printer to cover the cost of the reports mentioned, and can not be used for any other purpose; it therefore constitutes a fixed charge against the allotment for printing.

The following is a list of the reports to be prepared annually for submission to Congress, concerning the printing of which there is no specific provision:

Appointments and promotions in the Department on lump-sum funds.
Estimates and expenditures.
Book of Estimates—statement concerning employees.
Expenditures from contingent fund of Department.
Annual statement of proceeds of public property.
Operations of the Bureau of Animal Industry.

These reports are not always printed, and evidently it was contemplated by Congress that the printing of such reports should be left to the wisdom of that body, as the law (public, 153, approved March 1, 1907) provides that they shall be forwarded to Congress with an estimate from the Public Printer of the probable cost thereof. Nevertheless, during the last fiscal year, the amount charged against this Department for the printing of these publications was $4,748.90, which is believed to be an unjust burden upon the Department and one not authorized by law. Moreover, special reports are frequently called for by Congress, which could not possibly be anticipated and for the first cost of printing which it is not possible to make an intelligent estimate. During the last year the amount of such charges, which could not be anticipated or estimated for, was $2,227.06. A conservative and safe reserve for the cost of congressional publications is $60,000. It is understood that the Joint Committee on Printing desired to fix upon the executive departments only the cost of such publications as were already required to be printed under the law, and that as regards all other reports which were required to be submitted to Congress the cost of the printing, if ordered, should be borne by Congress and not by the Department. This matter has already been taken up with the Public Printer.

DISPOSITION OF PRINTING FUND.

The allotment for printing and binding for the Department of Agriculture for the last fiscal year was $433,750, against which amount there are what might be called the usual annual fixed charges, approximately as follows:

For the Weather Bureau	$25,000
For Farmers' Bulletins	98,750
Congressional publications	60,000
Expenditures for blanks, blank books, etc	63,000
Maintenance of branch printing office	43,000
Periodical publications	30,000
Total	319,750

This leaves a balance of only about $114,000 available for the publication of results of scientific inquiry and the general publication work of the Department, a sum which is quite inadequate to meet the requirements of the Department for such publications, a number of which could not be published last year for lack of funds. Particular attention is invited to the item of periodical publications in the above statement, which involves an expenditure from the printing fund amounting to $30,000. These publications and the cost of each are shown in the following statement:

Experiment Station Record	$11,124.00
Crop Reporter	11,585.28
Field Programme (Forest Service)	1,208.88
Service Announcements (Bureau of Animal Industry)	430.68
Monthly List of Publications (domestic and foreign)	3,549.96
Schedule of Wholesale Lumber Prices	1,200.00
List of Station Publications Received by the Office of Experiment Stations	387.48
Monthly Weather Review (paid for from the allotment of the Weather Bureau).	
Total	29,485.28

These publications involve a fixed charge, approximately as stated, and because of their periodicity the expense of their publication is increased. It is recommended, therefore, that this class of publications be not increased, as such increase will reduce the amount available for publishing results of important scientific investigations.

It is apparent from the figures herein given that a considerable increase in the printing fund is necessary to make available for the public the information collected by the Department. Accordingly, an estimate of $50,000 additional has been submitted.

This year, as last, the number of copies of the congressional publications ordered for the use of the Department has been reduced to the minimum. The Public Printer will be advised of the number it is proposed to order under the provisions of public resolution 13, which permits the Department to make requisition for only a portion of the allotment, by which means it is hoped that a considerable sum may be deducted from the amount reserved for congressional publications and made available for general printing.

REPRINT OF SPECIAL REPORT ON DISEASES OF CATTLE.

Following is the text of the resolution (H. R. 176) passed at the first session of the Sixtieth Congress, approved by the President May 23, 1908, providing for the printing of the Special Report on Diseases of Cattle:

> *Resolved by the Senate and House of Representatives of the United States of America in Congress assembled*, That there be printed and bound one hundred thousand copies of the Special Report on the Diseases of Cattle, the same to be first revised and brought to date under the supervision of the Secretary of Agriculture; thirty thousand copies for the use of the Senate; sixty thousand copies for the use of the House of Representatives and ten thousand copies for distribution by the Department of Agriculture.

The copy was in course of preparation at the close of the fiscal year, and it was expected that the same would be forwarded to the printer about the 1st of October. Two entirely new articles are to be included in the work, taking the place of two that are now out of date. The other revisions comprise but slight changes in the text and illustrations. An edition of 4,000 copies will probably be ordered for the Department, for distribution to crop correspondents and collaborators.

PRACTICE OF ECONOMY IN THE PRINTING FOR THE DEPARTMENT.

With a view to emphasizing the necessity for most rigid economy in the expenditure of printing funds allotted to the Department, the Secretary approved May 21, 1908, the following recommendations of the Advisory Committee on printing and publication work:

May 21, 1908.

To Chiefs of Bureaus, Divisions, and Offices:

The gradually increasing demand for printing required by the Department without a corresponding increase in the appropriation for the ensuing fiscal year emphasizes the necessity for the practice of the most rigid economy in every detail in the printing of blanks, blank books, bulletins, circulars, pamphlets, etc. Every blank should be carefully scrutinized, and after the necessity for it has been established, it should be printed in the most economical size and style. As regards publications, the effort should be made to condense the subject-matter to the fewest possible words, and in the printing of the same every device for reducing the cost should be employed, and mechanical make-up and uniformity of style, however desirable, when possible must be sacrificed in the interest of economy. Circulars should be published without covers, title-pages, organization lists, contents, lists of illustrations, or other unnecessary matter.

As regards blanks, considerable money could be saved by the use of less expensive paper. There are very few blanks which require linen ledger, the ordinary white writing paper being suitable. For blank books good heavy ledger will generally meet all requirements.

The order of the Secretary relating to corrections in proof should be strictly enforced, as the editing in proof, if permitted, may add one-third—and in some cases even more—to the cost of a publication. Only absolutely necessary illustrations should be permitted. Great care should be exercised in the selection of illustrations for publications. Only those should be used that convey some meaning that can not be expressed in words.

The Division of Publications is hereby authorized and enjoined to enforce the most rigid economy in the printing and binding required by the Department, and the Department Editor is empowered to do everything which may in his judgment reduce the expense of the work without detracting from the quality thereof, the object being to secure the greatest amount of the best work from the fund appropriated.

Chiefs of bureaus, divisions, and offices shall cooperate with the Division of Publications in the carrying out of the recommendations herein made.

W. M. Hays,
Willis L. Moore,
Geo. Wm. Hill,
Advisory Committee.

Approved.
James Wilson, *Secretary.*

As a further means of enforcing economy, the Secretary on July 1, 1908, issued the following order relative to the use of "rush slips" for printing.

To chiefs of bureaus, divisions, and offices:

My attention has been called to the increasing use of the red ticket or "rush" slip as applied to the printing ordered for the various bureaus, divisions, and offices. Inasmuch as an extra charge of 20 per cent is hereafter to be made by the Public Printer for rush work, it is imperative that the number of such orders be reduced to the minimum, and I have accordingly instructed the Editor and Chief of the Division of Publications that no rush order will hereafter be sent to the Public Printer without the signature of the Secretary.

There is rarely any excuse for rush orders for blanks, blank books, letter heads, envelopes, etc., as it should be the duty of some person in each bureau to look after such matters and make requests for additional supplies before the stock on hand is exhausted. As regards bulletins, circulars, and pamphlets, ample time must be allowed and the use of the red ticket avoided. The printing fund is already insufficient for our actual requirements and every effort must be made to reduce, rather than to increase, the cost of printing.

Very respectfully, James Wilson, *Secretary.*

It must be admitted that the practice of affixing "rush" slips to requests for printing had become too prevalent—so much so, indeed, that the object sought was often not obtained, for, as a rule, where everything is marked "special" nothing is made special. Moreover, it was learned that the Public Printer had decided to affix a charge of 20 per cent additional for rush work, which decision caused the Secretary to promptly issue the order above given. It is particularly desirable to avoid the necessity of ordering printing one day the delivery of which is desired the next. Of course there may be instances when such a course is justifiable, but as a rule they will not arise if proper care be exercised by the various bureaus, divisions, and offices in the handling of their supplies. The pink warning slips are now furnished by the printer with all work delivered. These slips are designed for insertion at convenient places to serve as a warning that the supply is running low and that an order for a reprint should be placed when these slips are reached in the distribution of blanks, blank books, etc. The rush slips should be used only in cases of great emergency, and if this restriction be observed, as it must be under the Secretary's order, a considerable saving will be effected in the printing fund of the Department.

THE EDITORIAL SECTION.

This section is under the immediate supervision of the Associate Editor. The policy of keeping the chiefs of bureaus informed concerning the scope and character of all manuscripts submitted for publication has been continued with satisfactory results. This policy tends to prevent duplication of published matter and to maintain clear lines of separation between the spheres of the different bureaus. Perhaps the most striking feature of this section's work during the year was its success in the promotion of economy. Many manuscripts were reduced in size from 10 to 40 per cent. Particular attention was given to the condensation and general improvement of tabular matter, which always affords opportunity for the exercise of economy in its preparation. All drawings and photographs submitted for illustrations were carefully scrutinized, and many of them regarded as unnecessary were omitted. The economy effected in this line of work, however, is not limited to the manuscripts and illustrations actually submitted. The Division's stand in favor of economy in publication work has exerted a healthful influence throughout the Department, tending to the more careful preparation of manuscripts and to a closer sifting of the illustrations in the various offices in which the publications originated. The most striking proof of this claim is found in the statistics of the Department's publication work. Notwithstanding the great growth of the Department and the greatly broadened scope of its operations, the number of printed pages of its new publications is very little in excess of the average figure for a number of years past.

During the year the Associate Editor was fully occupied in supervising the work of his assistants, keeping the records, necessary consultations with authors and bureau chiefs, and conferences with the Government Printing Office. The actual work of reading and revising the manuscripts and correcting proofs was done by the five assistant editors. The publications receiving editorial attention during the year contained an aggregate of 22,028 printed pages. The editorial work on these publications involved the reading, revision, and preparation of about 38,000 pages of manuscript, the reading and correction of nearly 11,000 galleys of proof, and the revision of about 45,000 pages of first and second page proofs.

The job work done in the branch printing office was revised and proof read in this section. As the number of jobs to receive attention numbered 4,575, it will be seen that this line of work is of great importance.

Cards are prepared for an up-to-date card catalogue of all Department publications as they are received from the printer. A small stock of all the Farmers' Bulletins and of most other publications of the Department is kept in the editorial section in order to promptly supply copies in response to special requests. At the request of the United States Civil Service Commission several hundred examination papers relating to proof reading, etc., were read and rated during the year, part of this work being done in the indexing section and part in the editorial section. The foregoing will suffice to illustrate the miscellaneous duties of the editorial force. Such work consumes much time and is of great value, yet it can not be included in any statistical summary of results accomplished.

THE DOCUMENT SECTION.

On July 1, 1907, there were 2,732,069 copies of different publications in the document section, and 18,514,809 copies were received from the Public Printer during the twelve months ended June 30, 1908, making an aggregate of 21,246,878 in the document section, of which number 8,020,141 were Farmers' Bulletins and 13,226,737 were miscellaneous publications other than Farmers' Bulletins. Of these, 18,442,755 were distributed, of which 6,687,019 were Farmers' Bulletins and 11,755,736 were miscellaneous publications, leaving a balance in stock at the termination of business June 30, 1908, of 2,804,123 copies. about half of which were Farmers' Bulletins.

CORRESPONDENCE.

The correspondence connected with the distribution of documents consisted of 38,081 dictated and other letters prepared for the signature of the Secretary by the Chief of the Division and the assistant in charge and over 300,000 letters to which replies were made on blanks filled up by the clerical force over the printed signature of the Chief of the Division. It was necessary to address franks and envelopes for mailing bulletins, Crop Reporters, Monthly Lists, and other publications, amounting to approximately 7,500,000, one-fifth of which were prepared on the addressing machines now in regular operation in the document section.

FOREIGN MAIL.

By far the larger portion of the publications are, of course, distributed to residents of the United States, but in the aggregate a large number of books are sent to foreign countries, and the extra work involved in recording and mailing packages addressed to foreign countries occupies the larger portion of the time of one employee. The following is a summary of the work:

Packages of publications sent abroad during the fiscal year 1908.

Item.	Number.	Weight.	Postage paid by Department.
		Pounds.	
Packages sent abroad (Canada, Mexico, and Cuba not included)	60,898	20,225½	$1,904.85
Packages sent to Canada, Mexico, and Cuba	21,508	4,400½	None.
Packages sent to Smithsonian Institution, to be sent to foreign addresses	69	286	None.
Total	82,475	24,912	1,904.85

Mail sacks used (domestic and foreign): No 2, 22,801; No. 3, 7,074; total, 29,825.

LABOR-SAVING DEVICES.

The additional clerical assistants added to the force on July 1, 1907, and the additional skilled laborers provided for under the appropriation for the year beginning July 1, 1908, furnish a number of employees more nearly adequate to the demands of the work than has heretofore been the case, but the work continues to increase in greater amount than the increased force will be able to handle in a satisfactory and efficient manner unless aided in some other way. This we are attempting to do by introducing labor-saving machines. If the appropriations asked for and approved by the Secretary are granted, it will enable us to so increase the machines and labor-saving devices as to relieve a large force of clerks from the duty of addressing envelopes and writing franks and permit their employment at other urgent work. It is only by some such arrangement that it will be possible to handle the increase of work. The mailing equipment now comprises the following machines: Two foot-power addressing machines, two foot-power stencil cutters, and two No. 2 automatic paper-folding machines. With these machines the following work was accomplished during the year:

Number of envelopes and franks addressed	1,564,284
Copies of Monthly List folded	2,115,000
Number of miscellaneous circulars folded	986,000

The use of stencils in addressing envelopes and franks, adopted some time ago, continues to be satisfactory, and this method is being applied to all permanent lists as rapidly as possible. It is proposed to use the stencils for the entire list to which the Monthly List of Publications is sent. For this list 133,750 stencils have been prepared and are in use, leaving 102,000 names and addresses which have not yet been cut, and which are now addressed by hand. The number of stencils belonging to the other bureaus of the Department and kept in the document section is 82,976. During the year 71,804 stencils were cut for the Monthly List; 5,937 for miscellaneous lists; 2,454 were removed from the Monthly List, and 2,082 were removed from the miscellaneous lists. The addresses now on stencils number 216,726, and in order to use stencils for all lists in our possession, new supplies and the addition to the equipment of an electric machine for cutting stencils and an electric addressing machine will be required.

The introduction of other machinery would undoubtedly expedite the work, as a franking machine to paste address labels of Senators, Representatives, and Delegates on envelopes in which bulletins are to be mailed, approximately 5,000,000 of these franks being used annually, all of which are now pasted on by hand; and an additional sealing machine, larger and more satisfactory than those now possessed by this office, would greatly relieve the employees of much time-consuming work and obviate the necessity for an increased number of employees.

THE SECTION OF ILLUSTRATIONS.

The number of drawings made by our draftsmen during the year aggregated 1,967, without any increase in the cost of performing the work or in the force employed. Attention is called to the importance and necessity of having draftsmen of exceptional ability, fidelity, and experience, as the work required is of varied character, covering practically the entire field of illustration, and such draftsmen are not readily secured and can be retained only by the payment of adequate compensation.

The photographic work has grown beyond our ability to handle with the small force and inadequate equipment available. The result is that the work is from four to six months in arrears, and it is impossible to bring it up to date without additional assistants and equipment. It is gratifying to report that the bureaus, divisions, and offices of the Department are availing themselves of our expert assistance, and would, it is believed, willingly turn over all their photographic work to us if the illustrations section were manned and equipped to perform it. Field photography was done during the year for the Bureau of Plant Industry, the Bureau of Animal Industry, and the Bureau of Entomology. Unfortunately the force was so small that it was not possible to comply with all requests for work of this character; however, every effort was made to meet the demand, for the reason that the photographs thus obtained will be used to illustrate the reports on investigations made by the Department's scientific force, and should be technically and artistically of the highest order.

Negatives are being added constantly to the files and indexed as rapidly as possible, as the concentration of the negatives greatly facilitates the work. There is a constant increase in the requests from miscellaneous applicants for prints, lantern slides, etc., usually selected from illustrations in our publications. Most of these requests come from newspaper, magazine, and syndicate correspondents, who want their prints at very short notice. In locating negatives to fill these requests much time is spent that could be devoted to other work if the negatives used to illustrate the departmental publications were filed in this office. If the money received for photographic prints were not turned into the Treasury, as now required by law, but were made available for the purchase of material from time to time, the special fund of this Division would be relieved of a considerable sum which could be spent to advantage in the purchase of supplies required in executing orders from the various bureaus, divisions, and offices of the Department.

It is gratifying to state that near the close of the year additional room was secured, so that the quarters now occupied by the illustrations section comprise practically the entire fourth floor of the main building. This enlargement will facilitate the growth of the work and the employment of additional assistants.

The following is a detailed statement of the work done for the different branches of the Department during the year, as well as the aggregate amount of such work:

Photographic work done for the different bureaus, divisions, and offices of the Department and for the public during the fiscal year ended June 30, 1908.

Bureau, division, or office.	Velox prints.	Albuma prints.	Repro prints.	Blueprints.	Solar bromide prints.	Bromide enlargements.	Lantern slides made.	Lantern slides colored.	Negatives made.	Negatives developed.
Assistant Secretary	388	1		7	42		79		188	
Bureau of Animal Industry	3,392	509		1,716		222	407		289	995
Bureau of Chemistry	914	13		867		22	103		175	236
Bureau of Entomology	491	841					240		215	206
Office of Experiment Stations	1,083	116		720	30		317		145	338
Bureau of Plant Industry	17,345	1,879		1,055	9	185	833		1,246	1,953
Division of Publications	2,423	76	29	1	1				17	
Office of Public Roads	280	760		192		36	64		59	269
Bureau of Statistics	76			3	12				18	
Bureau of Soils					8				4	6
Disbursing office	8								4	
Chief engineer				4						
Biological Survey					20					
Paid orders	375	749			8	111	660	6	44	

Summary of work done in the section of illustrations during the fiscal year ended June 30, 1908.

Photographic work:	
Velox prints	26,775
Albuma prints	4,944
Blueprints	4,565
Solar bromide prints	130
Repro prints	29
Bromide enlargements	551
Lantern slides	2,703
Lantern slides colored	71
Negatives made	2,404
Films and plates developed	4,003
Paid requisitions, 92, amounting to	$662.69
Drawings, electrotypes, etc.:	
Drawings made	1,967
Requests received for duplicate electros	163
Duplicate electros furnished to correspondents on request	1,570
Illustrations printed or published, not including reprints	1,697

THE INDEXING SECTION.

CARD INDEX OF AVAILABLE PUBLICATIONS.

The making of a general index to the publications of the Department, going back to the date of its establishment, with the view to furnishing easy reference to every topic discussed in these publications, has been suspended because of the increase of work in connection with the indexing of publications available for distribution. The index of available publications was brought into use in the fall of 1907, although a part of the publications, included in those available, have never been fully indexed. It has been found that inquiries upon general topics can be answered conveniently by the use of this index, even in its present imperfect state. It is particularly valuable in answering inquiries of an unusual and varied character. During the last eight months of the fiscal year over 5,000 letters were answered and the applicants supplied with the publications wanted or advised where they could procure them. In many cases the letters could not have been satisfactorily answered without the index as a guide, because it would have been practically impossible to ascertain what books were wanted. Many letters have been received expressing appreciation of assistance thus rendered. Constant use of this index reveals certain deficiencies, toward the correction of which considerable time and labor have been expended, including the perfecting of cross references. The adjustment of this index of available publications to its practical use in the distribution of publications has called for the personal attention of the assistant in charge of indexing, and a considerable portion of his time has been given to preparing answers to applicants for publications.

SOME OF THE WORK DONE.

Besides the work of making and using an available index, thousands of copies of new cards have been made for other indexes, and a considerable amount of work has been done for the United States Civil Service Commission in the preparation of questions and the examination of over 500 sets of papers. Also the Monthly List of Publications has been compiled and issued regularly and promptly, and lists of publications for sale and for free distribution, as well as the subject-index of the Farmers' Bulletins, have been revised and issued from time to time as occasion required. An index for the food-inspection work was prepared upon the request of the Bureau of Chemistry. Indexes have been made for many of the publications of the various bureaus, divisions, and offices of the Department; also the usual indexes for the Yearbooks, Annual Reports, Farmers' Bulletin volumes, etc. An index was made for the laws applicable to the United States Department of Agriculture, compiled by the solicitor. An index of the first 250 Farmers' Bulletins was prepared and published as Bulletin 8 of this division, and much work was done on the index to the Yearbooks, 1901–1905, now about to be issued as Bulletin 9 of this division. Circular 1 of this Division, showing the organization of the Department, was revised to show the personnel of the different branches of the Department during the first half of 1908; also that part of the Yearbook Appendix which is issued separately as a Farmers' Directory and serves to bring the organization circular up to date for the last half of each year. The section of indexing is also charged with receiving and keeping copies of all publications of the Department for binding for permanent preservation and a considerable portion of the time of two members of the force has been given to this work.

MISCELLANEOUS NEW WORK.

At the time of the occupation of the new building the two complete sets of the Department publications were transferred from the vault where they had been stored for several years, at a cost of $60 per year, to the attic of the east wing of the new Department building, where they are packed in boxes and are inaccessible. It is desired now to unbox them and place them on the shelves, where at least one set can be examined, kept in order, and used as occasion requires.

During the year a large office room in the main building, adjoining the editorial section, was secured for the indexing work, and some additional clerks were assigned to this section, which will make possible the resumption of some of the work on the general index. Still, despite the extra time devoted by the assistant in charge it has not been possible to keep the work up, nor can this be accomplished without the services of an additional expert indexer.

A new field of work is suggested by the calls for information which can best be answered by state agricultural officials or other branches of the state government. The policy of cooperation between the Department and State commissioners of agriculture makes necessary mutual understanding and helpfulness in the publication and distribution of agricultural information

BRANCH PRINTING OFFICE.

The following is a condensed statement showing the work done in the Branch Printing Office during the year:

	Copies.
Blanks	9,374,135
Envelopes	2,722,570
Letter heads	2,349,670
Slips	1,738,025
Cards	3,867,387
Franks	1,835,250
Labels and tags	1,907,146
Miscellaneous	3,745,076
Circular letters and other notices	1,764,609
Circulars (numbered)	776,200
Total	30,080,068

This Division still adheres to the opinion that the Branch Printing Office is a necessary adjunct to the Department for the expeditious printing of numerous circulars, decisions, regulations, blanks, letter heads, etc. It is earnestly hoped that suitable quarters may be provided for the Branch Office in the new administration building, in which event the Public Printer has expressed the determination to equip the office with modern and improved machinery, type, etc., for the more expeditious handling of the large volume of work that is constantly being turned over to this office. Mr. George L. Sherman is the foreman in charge, and his cheerful cooperation and the efficiency of the force under him are worthy of commendation.

RECOMMENDATIONS.

Pursuant to your instructions that in preparing the estimates for the ensuing year professional and expert services be provided for on the lump-sum and purely administrative, clerical, and labor services be carried on the statutory roll, the editorial force, including the Assistant Chief and the Associate Editor, as well as the Assistant in Charge of Indexing, have been transferred in the estimates from the statutory to the lump-sum fund as coming under the head of professional services. As experts also in their line of work, the Assistant in Charge of the Illustrations section and the draftsmen and photographers employed under his supervision have also been estimated for on the lump fund, being transferred thereto from the statutory roll.

I earnestly hope that it will be found possible at an early date to revise the salaries of the editorial assistants so as to afford them remuneration adequate to the service rendered. The position of assistant editor in the Division of Publications calls for a combination of qualifications that are not very commonly found united in the same person, namely, a thoroughly good education, a general knowledge of agricultural subjects, experience and training in the art of printing, sound judgment, and last, but not least, a plentiful supply of tact. The possession and judicious use of these qualifications have, apart from the protection afforded to the Secretary in the printing of the Department publications, resulted in a considerable improvement in style and form, and a very considerable economy in the work of publication in accordance with the Secretary's emphatic instructions on this point. It is a very conservative statement to say that the work of the editorial force of this Division reduces the cost of printing annually by an amount fully equal to twice the total expenditures involved in carrying on this branch of the work.

The value of the indexing work undertaken a few years ago has been, in spite of our very inadequate force, made strikingly manifest, sufficiently so to justify recommending the promotion of the assistant in charge and the assignment to him of a special assistant to be appointed after passing a special examination for indexing such as will prove him an expert in this class of work, capable also of acting in charge of the section during the absence of the assistant in charge and of relieving the latter of a considerable share of the correspondence.

The accumulation of work in the section of illustrations is such as to cause no little worry as regards the photographic work, which has been increasing by leaps and bounds during the past year, taxing to the utmost our inadequate facilities in both equipment and help. I take it to be a matter beyond dispute that the interests of both economy and efficiency in this line of work will be served materially by concentration of all work of this class under the Division of Publications, thus avoiding the multiplication of costly equipment in the several bureaus. Judging by the manner in which work has been rushed in on us from the several bureaus, the opinion just expressed seems to be very generally supported throughout the Department. At present we can only do the best we can with the facilities available, increasing the same as rapidly as the liberality of our appropriations will permit, and thus gradually preparing for a general concentration of this work, which can only be thoroughly effected by the allotment of suitable space in the new administration building, when that is possible, and supplying us with the latest, most up-to-date equipment.

The rapid increase of work in the document section has taxed our force to the utmost, and with every prospect of a continued increase the question of meeting the additional demands upon us in this line of work becomes most urgent. Either we must have a very large addition to the force or we must reduce the hand labor by the increased use of labor-saving mechanical devices. In the interests of economy and efficiency the latter course is the one I should strongly recommend. In the first place, space is lacking to accommodate the additional number of clerks and laborers which would be necessary, and their salaries would form a perpetual drain upon our resources. On the other hand, a substantial enlargement of our facilities in the way of mechanical devices, while involving considerable cost at the start for purchase and installation, would be a saving of money in the long run, besides tending to eliminate largely the unavoidable possibilities of error inseparable from hand work. In the hope that Congress will concur in this view, the additional help asked for in the estimates for the forthcoming year is very slight, but with your approval we have asked for an increase in the upper grades of both clerks and laborers, while on the other hand we have eliminated entirely in the estimates all clerks and skilled laborers getting less than $720 per annum. While the recognized wages of unskilled laborers are maintained at $600 and $660 per annum, it seems only fair and reasonable that the lowest rate of pay for the services of clerks or skilled laborers should be at the rate of $720. Moreover, now that all these places have to be filled by certification from the Civil Service Commission, it is becoming more difficult, as a rule, to secure competent help for this money. When we do secure competent persons at this salary, they usually accept the employment with the fixed intention and earnest desire to secure a transfer at the earliest opportunity to some other bureau at more adequate pay.

Finally, I would recommend, in view of the multiplication of editors in the several bureaus, and with a view to clearly indicating the respective duties and responsibilities of these officials and of the Editor and Chief, that the latter be designated in the appropriation bill as "Department Editor, who shall be chief," etc.

STATISTICS OF THE PUBLICATION WORK.

The details of the publication work of the Department, including the appropriations made and the expenditures during the year, are given in the tables which follow:

Number and classes of publications issued during the fiscal year 1908.

Publications:	
Chargeable to regular printing fund (including Farmers' Bulletins)	1,404
Printed as executive documents	41
Edited at Weather Bureau	77
Total	1.522

Number of publications, original and reprint, and number of pages and copies of each class, fiscal years 1906–1908.

Character of publications.	1906			1907			1908		
	Number of publications.	Pages.	Copies	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.
Original	414	20,942	6,423,400	521	20,479	9,226,000	447	22,028	9,408,903
Reprints	654	29,491	6,134,000	819	30,422	6,786,000	998	35,536	6,820,850
Weather Bureau	103	1,553	930,621	75	1,462	734,910	77	946	645,763
Total	1,171	51,986	13,488,021	1,415	52,363	16,746,910	1,522	58,510	16,875,516

Number of publications issued (including reprints) during the three years, 1906 to 1908, inclusive.

Year.	Number of publications.	Total number of copies.
1906	1,171	13,488,021
1907	1,415	16,743,910
1908	1,522	16,875,516
Total	4,108	47,107,447

Number of publications (original and reprint) and number of copies and pages, by bureaus, divisions, and offices, fiscal year 1908.

Bureau, division, or office.	Publications.			Pages.			Number of copies.		
	Original.	Reprints.	Total.	Original.	Reprints.	Total.	Original.	Reprints.	Total.
Secretary's office	12	11	23	526	352	878	89,500	64,200	153,700
Congressional documents	40	1	41	5,191	135	5,326	175,238	3,000	178,238
Accounts and Disbursements	1	......	1	38	....	38	200	....	200
Animal Industry	38	133	171	1,306	4,088	5,394	134,500	1,148,300	1,282,800
Biological Survey	17	22	39	799	613	1,412	107,300	118,000	225,300
Chemistry	21	37	58	2,402	2,905	5,307	44,700	110,200	154,900
Entomology	36	76	112	892	2,924	3,816	121,300	383,750	505,050
Experiment Stations	61	257	318	4,248	11,536	15,784	402,300	1,957,650	2,359,950
Forest Service	57	163	220	1,177	3,510	4,687	3,891,400	426,800	4,318,200
Library	5	......	5	319	....	319	4,300	....	4,300
Plant Industry	73	221	294	2,345	6,403	8,748	453,865	2,065,250	2,519,115
Publications	33	19	52	655	856	1,511	2,180,000	142,500	2,322,500
Public Roads	10	17	27	282	535	817	93,800	199,000	292,800
Soils	10	24	34	416	1,149	1,565	23,500	154,200	177,700
Statistics	34	9	43	1,432	530	1,962	1,687,000	13,000	1,700,000
Weather Bureau	76	8	84	750	196	946	645,263	35,500	680,763
Total	524	998	1,522	22,778	35,732	58,510	10,054,166	6,821,350	16,875,516

Amount expended for the various bureaus, divisions, and offices for printing and binding, 1908.

Division of Accounts and Disbursements	$6,095.43
Bureau of Animal Industry	16,366.83
Bureau of Biological Survey	5,980.11
Bureau of Chemistry	13,035.87
Bureau of Entomology	6,660.92
Office of Experiment Stations	26,424.85
Forest Service	90,907.78
Library	5,930.59
Bureau of Plant Industry	18,990.19
Division of Publications	7,785.45
Office of Public Roads	1,477.15
Bureau of Soils	3,164.13
Bureau of Statistics	22,905.12
Miscellaneous	5,936.77
Printing at branch printing office for the various bureaus, divisions, and offices	39,476.30
Congressional	34,447.71
Total	305,585.20

Farmers' Bulletins issued, 1906–1908.

Year and class.	Number of bulletins.	Number of copies.
Fiscal year 1908:		
Originals	26	560,000
Reprints	589	6,014,500
Total	615	6,574,500
Fiscal year 1907:		
Originals	42	1,100,000
Reprints	443	5,369,000
Total	485	6,469,000
Fiscal year 1906:		
Originals	33	875,000
Reprints	404	5,693,000
Total	437	6,568,000

Cost of printing Farmers' Bulletins, 1906–1908.

Fiscal year.	Paid from—	Number of bulletins.	Number of copies.	Cost.
1908	General printing fund	615	6,574,500	$98,683.25
1907	Farmers' Bulletin fund	485	6,469,000	98,601.17
1906	.....do.	437	6,568,000	98,601.49

New Farmers' Bulletins issued during the fiscal year 1908.

No. of bulletin.	Title of bulletin.	Total number of copies.
302	Sea Island Cotton: Its Culture, Improvement, and Diseases	10,000
303	Corn Harvesting Machinery	20,000
304	Growing and Curing Hops	15,000
305	Experiment Station Work—XLII	30,000
306	Dodder in Relation to Farm Seeds	15,000
307	Roselle: Its Culture and Uses	10,000
308	Game Laws for 1907	30,000
309	Experiment Station Work—XLIII	30,000
310	A Successful Alabama Diversification Farm	10,000
311	Sand-clay and Burnt-clay Roads	30,000
312	A Successful Southern Hay Farm	15,000
313	Harvesting and Storing Corn	30,000
314	A Method of Breeding Early Cotton to Escape Boll-weevil Damage	20,000
315	Progress in Legume Inoculation	15,000
316	Experiment Station Work—XLIV	20,000
317	Experiment Station Work—XLV	30,000
318	Cowpeas	30,000
319	Demonstration Work in Cooperation with Southern Farmers	30,000
320	Experiment Station Work—XLVI	30,000
321	The Use of the Split-log Drag on Earth Roads	30,000
322	Milo as a Dry-land Grain Crop	10,000
323	Clover Farming on the Sandy Jack-pine Lands of the North	10,000
324	Sweet Potatoes	20,000
325	Small Farms in the Corn Belt	20,000
326	Building up a Run-down Cotton Plantation	20,000
327	The Conservation of Natural Resources	30,000

Farmers' Bulletins contributed by bureaus, divisions, and offices, 1908.

Bureau, division, and office.	New.	Reprints.	Number of copies.
Bureau of Animal Industry		80	988,500
Biological Survey	1	15	110,000
Bureau of Chemistry		11	90,000
Bureau of Entomology		39	302,000
Office of Experiment Stations	7	190	1,864,000
Forest Service	1	11	130,000
Bureau of Plant Industry	15	195	2,025,000
Division of Publications		15	130,000
Office of Public Roads	2	13	190,000
Bureau of Soils		13	150,000
Weather Bureau		7	35,000
Total	26	589	6,014,500

Number of copies of Farmers' Bulletins issued (Nos. 1 to 327) and number distributed to Members of Congress, 1894–1908.

Date.	Total number of copies issued.	Congressional distribution.	Date.	Total number of copies issued.	Congressional distribution.
Prior to 1894	540,000		1902	6,150,000	4,289,126
1894	278,500		1903	6,602,000	3,954,976
1895	1,567,000	885,770	1904	6,435,000	4,895,556
1896	1,891,000	1,316,695	1905	5,925,500	4,782,643
1897	2,387,000	1,967,237	1906	6,568,000	5,279,476
1898	2,170,000	1,580,065	1907	6,469,000	3,484,713
1899	2,437,000	1,101,985	1908	6,574,500	3,928,437
1900	2,360,000	1,666,909			
1901	3,345,000	2,195,010	Total	61,699,500	31,328,598

New Farmers' Bulletins issued each year from 1895 to 1908, inclusive.

Year.	Number of bulletins.	Year.	Number of bulletins.
1895	11	1903	22
1896	13	1904	25
1897	16	1905	24
1898	21	1906	33
1899	22	1907	42
1900	18	1908	26
1901	14		
1902	23	Total	310

Appropriations for the fiscal years 1907–1909.

Appropriation.	1907	1908	1909
Statutory roll	$116,270	$126,550	$179,710
General printing fund	[a] 275,000	[a] 408,750	[a] 435,000
Preparation, printing, and distribution of Farmers' Bulletins	98,750	([b])	([b])
Additional assistants, artists, draftsmen, etc	3,500	[c] 35,000	[c] 40,000
Labor, material, wagons, horses, rent of building, etc	30,000		
Total	523,520	570,300	654,710

[a] Exclusive of $25,000 for Weather Bureau.

[b] Included in general printing fund, $98,750 in 1908, $125,000 in 1909.

[c] Additional assistants and labor and material appropriations combined under title "Publications, Department of Agriculture."

Expenditures under general appropriations for fiscal year ended June 30, 1908.

General printing fund (including Farmers' Bulletins)	$404, 268. 45
Publications, Department of Agriculture (labor, material, etc.)	34, 887. 51
Total	439, 155. 96

Expenditures for printing and binding, 1908.

General printing fund ($408,750 exclusive of $25,000 for Weather Bureau):	
Expended for the various bureaus, divisions, and offices	$266, 108. 90
Expended for Farmers' Bulletins	98, 683. 25
Expended for printing at branch office for the various bureaus, divisions, and offices	39, 476. 30
Total	404, 268. 45

Requisitions on the branch printing office by bureaus, divisions, offices, etc., 1908.

Secretary's office	215
Division of Accounts and Disbursements	167
Bureau of Animal Industry	532
Bureau of Biological Survey	76
Bureau of Chemistry	365
Bureau of Entomology	169
Office of Experiment Stations	324
Forest Service	711
Library	72
Bureau of Plant Industry	1, 142
Division of Publications	194
Office of Public Roads	73
Bureau of Soils	60
Bureau of Statistics	415
Miscellaneous	60
Total	4, 575

Publications printed in the branch printing office, 1908.

Bureaus, divisions, and offices.	Requisitions.	Number of copies printed.
Secretary's office	10	20,500
Bureau of Animal Industry	11	61,500
Bureau of Biological Survey	5	20,800
Bureau of Entomology	13	45,250
Office of Experiment Stations	3	3,600
Forest Service	4	20,000
Division of Publications	4	18,000
Office of Public Roads	2	1,100
Total	52	190,750

Requisitions on the main printing office by bureaus, divisions, and offices.

Secretary's office	33
Division of Accounts and Disbursements	77
Bureau of Animal Industry	330
Bureau of Biological Survey	63
Bureau of Chemistry	127
Bureau of Entomology	141
Office of Experiment Stations	369
Forest Service	725
Library	41
Bureau of Plant Industry	508
Division of Publications	91
Office of Public Roads	59
Bureau of Soils	91
Bureau of Statistics	64
Miscellaneous	6
Weather Bureau	14
Total	2 739

APPENDIX A.

PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1908.

[The following is a list of the publications issued during the fiscal year 1908, together with the number of copies ordered printed. Farmers' Bulletins are for free distribution by Members of Congress and also by the Secretary of Agriculture. Other publications for which no price is named are for free distribution by the Secretary of Agriculture, provided copies are available. All publications to which a price is affixed (including those of the Weather Bureau) are for sale by the Superintendent of Documents, Government Printing Office, to whom all copies not needed for official use are turned over in compliance with the law. To him all orders for such publications should be sent and not to the Department of Agriculture. Remittances may be made by postal money order. Do not send stamps.]

CONGRESSIONAL.

Advance sheets, Field Operations of the Bureau of Soils, 1905:	
Soil Survey of Chester County, Pennsylvania. July 27, 1907	4,000
Advance sheets, Field Operation of the Bureau of Soils, 1906:	
Soil Survey of Laredo Area, Texas. March 28, 1908	4,000
Soil Survey of Lancaster County, Nebraska. March 31, 1908	4,000
Soil Survey of the Williston Area, North Dakota. February 12, 1908	4,000
Soil Survey of Chesterfield County, Virginia. March 17, 1908	4,000
Soil Survey of Niagara County, New York. March 18, 1908	4,000
Soil Survey of Merrimack County, New Hampshire. March 23, 1908	6,000
Soil Survey of Meigs County, Ohio. March 25, 1908	4,000
Soil Survey of Grainger County, Tennessee. December 13, 1907	4,000
Soil Survey of Riley County, Kansas. January 25, 1908	1,000
Soil Survey of Putnam County, Missouri. January 28, 1908	4,000
Soil Survey of Racine County, Wisconsin. November 7, 1907	4,000
Soil Survey of Madison County, Tennessee. November 11, 1907	4,000
Soil Survey of Transylvania County, North Carolina. November 13, 1907	4,000
Soil Survey of Ransom County, North Dakota. October 23, 1907	4,000
Soil Survey of the Henderson Area, Texas. October 24, 1907	4,000
Soil Survey of Madison County, New York. November 15, 1907	4,000
Soil Survey of Blue Earth County, Minnesota. October 10, 1907	4,000
Soil Survey of the Crookston Area, Minnesota. October 16, 1907	4,000
Soil Survey of Greene County, Indiana. October 19, 1907	4,000
Soil Survey of the Tishomingo Area, Indian Territory. October 4, 1907	2,000
Soil Survey of the Fayetteville Area, Arkansas. October 5, 1907	4,000
Soil Survey of Prairie County, Arkansas. October 5, 1907	4,000
Soil Survey of the Wheeling Area, West Virginia. July 18, 1907	4,000
Soil Survey of Chester, Pennsylvania. July 27, 1907	4,000
Soil Survey of Chowa County, North Carolina. September 13, 1907	4,000
Soil Survey of Cass County, Michigan. September 14, 1907	4,000
dvance Sheets, Field Operations of the Bureau of Soils, 1907:	
Soil Survey of Wilson County, Texas. June 9, 1908	4,000
Soil Survey of Conway County, Arkansas. June 10, 1908	4,000
Soil Survey of Edgecombe County, North Carolina. June 23, 1908	4,000
Annual Report of the Office of Experiment Stations for the year ended June 30, 1906. July 31, 1907	5,000
Special Report on Diseases of the Horse. (Revised edition.) August 31, 1907	5,000
Progress of the Beet-Sugar Industry in the United States in 1906. Report No. 84. Reprint. November 15, 1907	3,000

Report of the Secretary of Agriculture on the Southern Appalachian and White Mountain Watersheds. Commercial Importance, Area, Condition, Advisability of their Purchase for National Forests, and Probable Cost. Senate Doc. No. 91, 60th Cong., 1st sess. January 16, 1908	30,684
Report on Work of Biological Survey. Message from the President of the United States. Senate Doc. No. 132, 60th Cong., 1st sess. February 1, 1908	100
Field Operations of the Bureau of Soils, 1905. (Seventh Report.) February 21, 1908	10,500
Twenty-third Annual Report of the Bureau of Animal Industry for the year 1906. February 28, 1908	5,000
Annual Report of the Department of Agriculture for the year ended June 29, 1907. Report of the Secretary of Agriculture. Departmental Reports. April 25, 1908	1,500
Estimates of Expenditure for Department of Agriculture, 1909. Letter from the Secretary of Agriculture, transmitting, pursuant to law, classified and detailed estimates of every subject of expenditure intended for the department for the next fiscal year. Senate Doc. 429, 60th Cong., 1st sess. April 22, 1908	50
Expenditures of the Department of Agriculture for the fiscal year ended June 30, 1907. Senate Doc. 425, 60th Cong., 1st sess. May 4, 1908	50
Operations of the Bureau of Animal Industry, 1907. Message from the President of the United States, transmitting Report of the Bureau of Animal Industry, Department of Agriculture, for the fiscal year ended June 30, 1907. Pp. 185. House Doc. 405, 60th Cong., 1st sess. May 15, 1908	1,854

OFFICE OF THE SECRETARY.

Report of the Secretary of Agriculture, 1907. Press copy. March 26, 1907.	2,700
Report of the Secretary of Agriculture, 1907. December 2, 1907	5,000
Report of the Appointment Clerk for 1907. (From Annual Reports, 1907.) January 18, 1908	300
Reprint, February 3, 1908	600
Report of the Secretary of Agriculture, 1907. Report No. 85. Pp. 100. February 3, 1908. Price 10 cents	5,000
Reprint, March 9, 1908	2,000
Reprint, March 25, 1908	1,000
Rules and Regulations for the Enforcement of the Food and Drugs Act. Cir. 21. Reprint, July 2, 1907	10,000
Reprint, November 11, 1907	15,000
Reprint, May 23, 1908	20,000
The Man Who Works with His Hands. Address of President Roosevelt at the Semi-Centennial Celebration of the Founding of Agricultural Colleges in the United States, at Lansing, Mich., May 31, 1907. Cir. 24. July 2, 1907	5,000
Reprint, August 28, 1907	5,000
Reprint, April 16, 1908	5,000
The Unproductive Farm. Address of Secretary of Agriculture at the Convention called by the Chamber of Commerce, Syracuse, N. Y., October 23, 1907. Cir. 25. October 28, 1907	2,000
Reprint, November 16, 1907	5,000
Temperature Changes in Fermenting Piles of Cigar-Leaf Tobacco. Report 60. Reprint, December 21, 1907	350
The Work of the Agricultural Experiment Stations on Tobacco. Report 63. Reprint, December 27, 1907	300
Cultivation of Cigar-Leaf Tobacco in Florida. Report 62. Reprint, January 7, 1908	400
Cultivation of Tobacco in Sumatra. Report 58. Reprint, January 14, 1908.	500
The Adulteration and Misbranding of Alfalfa, Red Clover, and Grass Seeds. Cir. 26. February 15, 1908	65,000
Ostrich Farming in Arizona. By Watson Pickrell, Tempe, Ariz. (Reprint from Yearbook, 1905.) Reprint, March 14, 1908	100

OFFICE OF THE SOLICITOR.

Report of the Solicitor for 1907. (From Annual Reports, 1907.) January 9, 1908	1,000
Reprint, January 23, 1908	500

Negligence of Employee Imputable to Carrier. Decision of the United States District Court for the District of Montana in cases involving violations of the act of Congress of June 29, 1906 (34 Stat., 607), commonly known as "the twenty-eight hour law." Cir. 1. March 2, 1908..........	1,000
Unit of Violation under "The Twenty-eight Hour Law." Opinion of the Circuit Court of Appeals for the Sixth Circuit in cases involving violations of the act of Congress of June 29, 1906, commonly known as "the twenty-eight hour law." Cir. 2. March 2, 1908..........................	1,000
"The Twenty-eight Hour Law" has the Incidents of a Civil Action. Opinion of the Circuit Court of Appeals for the Sixth Circuit on petition for rehearing, in cases involving violations of the act of Congress of June 29, 1906 (34 Stat., 607), commonly known as "the twenty-eight hour law." Cir. 3. April 7, 1908..	500
"The Twenty-eight Hour Law." Opinion of Judge Landis, of the Northern District of Illinois, in certain cases involving violations of the act of June 29, 1906 (34 Stat., 607). Cir. 4. May 16, 1908..........................	1,000
"The Twenty-eight Hour Law." Opinion of Judge Munger, of the District of Nebraska, overruling demurrer of defendant in cases involving violations of the act of June 29, 1906 (34 Stat., 607). Cir. 5. May 22, 1908....	500

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Report of the Chief of the Division of Accounts and Disbursements for 1907. (From Annual Reports, Department of Agriculture.) February 14, 1908..	200

BUREAU OF ANIMAL INDUSTRY.

Enzymes in Cornstalks and Their Relation to Cornstalk Disease. Cir. 84. (Reprint from Twenty-first Annual Report of the Bureau, 1904.) Reprint, July 2, 1907..	500
How to Get Rid of Cattle Ticks. Cir. 97. Reprint, July 2, 1907...........	25,000
Reprint, May 27, 1908..	16,000
The Tuberculin Test for Tuberculosis. (Reprint from Yearbook, 1901.) Cir. 79. Reprint, July 5, 1907..	1,000
The Preparation of Emulsions of Crude Petroleum. Cir. 89. Reprint, July 5, 1907..	2,000
Highland Cattle. (Reprint from Twenty-first Annual Report of the Bureau, 1904.) Cir. 88. Reprint, July 6, 1907..................................	500
Poultry Management. (Reprint from Twenty-second Annual Report of the Bureau, 1905.) July 6, 1907..	500
The Life History of the Twisted Wireworm (*Hæmonchus contortus*) of Sheep and Other Ruminants. (Preliminary report.) Cir. 93. Reprint, July 9, 1907..	500
Relative Proportions of the Sexes in Litters of Pigs. Cir. 112. July 11, 1907.	4,000
Reprint, August 27, 1907..	2,000
Classification for American Carriage Horses. Cir. 113. July 11, 1907.......	3,500
Reprint, September 20, 1907......................................	1,500
Reprint, March 3, 1908..	500
Reprint, June 3, 1908..	20,000
Index-Catalogue of Medical and Veterinary Zoology. Part 18. (Authors: Martius to Mitrofanow.) Bul. 39. July 30, 1907. Price 15 cents........	2,000
Baby Beef. Cir. 105. Reprint, August 5, 1907..........................	500
Quail Disease in the United States. (A Preliminary Report.) Cir. 109. Reprint, August 7, 1907..	1,000
Sanitary Milk Production. Report of a Conference Appointed by the Commissioners of the District of Columbia, with Accompanying Papers. Cir. 114. August 20, 1907..	5,000
Reprint, October 5, 1907..	2,500
Reprint, November 5, 1907..	5,000
Reprint, April 13, 1908..	2,500
Welsh Black Cattle. Cir. 104. Reprint, August 22, 1907.................	500
Distribution of Tuberculin and Mallein by the Bureau of Animal Industry. (Reprint from Yearbook, 1906.) August 28, 1907........................	1,000
Index-Catalogue of Medical and Veterinary Zoology. Part 19. (Authors: Mitschein to Myrepsus.) Bul. 39. August 24, 1907. Price, 15 cents.....	2,000
Officials, Associations, Commissions, and Educational Institutions Connected with the Dairy Interests of the United States for the Year 1907. Cir. 115. August 27, 1907..	3,500

Opportunities for Dairying. (Reprint from Yearbook, 1906.) August 30, 1907.	1,000
Reprint, March 26, 1908	1,000
Trichinosis: A Danger in the Use of Raw Pork for Food. Cir. 108. Reprint, September 6, 1907	1,000
Publications of the Bureau of Animal Industry. Cir. 106. Reprint, September 11, 1907	2,000
Reprint, November 12, 1907	4,000
Reprint, December 19, 1907	2,000
Capons and Caponizing. Cir. 107. Reprint, September 14, 1907	2,000
Osteoporosis, or Bighead. (Reprint from Special Report on Diseases of the Horse, revised edition, 1907.) October 5, 1907	10,000
A New Nematode (*Gongylonema ingluvicola*) Parasitic in the Crop of Chickens. Cir. 64. Reprint, October 7, 1907	1,000
Notes on Parasitic Nematodes, Including Descriptions of New Genera and Species, and Observations on Life Histories. Cir. 116. October 7, 1907..	1,000
Reprint, October 14, 1907	1,500
A Comparative Study of Tubercle Bacilli from Varied Sources. Bul. 96. Reprint, October 10, 1907. Price, 40 cents	1,000
Directions for the Use of Blackleg Vaccine. Cir. 23 (third revision). October 18, 1907	5,000
Reprint, January 16, 1908	10,000
A City Milk and Cream Contest as a Practical Method of Improving the Milk Supply. Cir. 117. October 29, 1907	7,500
Methods of Eradicating Cattle Ticks. Cir. 110. Reprint, October 29, 1907.	5,000
Texas Fever, or Southern Cattle Fever. Cir. 69. Reprint, November 7, 1907.	2,000
Blackleg: Its Nature, Cause, and Prevention. Cir. 31 (second revision). November 11, 1907	7,600
Reprint, January 27, 1908	5,000
The Danger from Tubercle Bacilli in the Environment of Tuberculous Cattle. Bul. 99. Reprint, November 13, 1907. Price 5 cents	5,000
The Relation of Tuberculous Lesions to the Mode of Infection. Bul. 93. Reprint, November 14, 1907. Price 5 cents	5,000
The Tuberculin Test of Hogs and Some Methods of Their Infection with Tuberculosis. Bul. 88. Reprint, November 14, 1907. Price 10 cents ...	5,000
Tuberculosis of Cattle. Cir. 70. Reprint, November 15, 1907	2,000
Report of the Chief of the Bureau for 1907. (From Annual Reports, 1907.) January 11, 1908	3,000
Report of the Chief of the Bureau for 1906. (From Annual Reports, 1906.) Reprint, January 29, 1908	300
Notes on Experiments with Blackhead of Turkeys. Cir. 119. December 5, 1907	3,000
Reprint, June 20, 1908	2,500
The Unsuspected but Dangerously Tuberculous Cow. Cir. 118. December 23, 1907	5,300
Reprint, February 4, 1908	2,000
Reprint, March 24, 1908	2,500
The Available Energy of Red Clover Hay. Bul. 101. January 10, 1908. Price 10 cents	1,600
Further Experiments Concerning the Production of Immunity from Hog Cholera. Bul. 102. January 22, 1908. Price 15 cents	3,500
Some Observations on Rabies. Cir. 120. January 29, 1908	2,500
Reprint, June 22, 1908	1,000
Osteomalacia, or Creeps, in Cattle. Cir. 66. Reprint, February 5, 1908	1,000
Epizootic Cerebro-spinal Meningitis of Horses. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) Cir. 122. February 7, 1908	2,000
Instructions for Preparing and Shipping Pathological Specimens for Diagnosis. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) Cir. 123. February 7, 1908	2,000
The Danish Hog Industry. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) February 7, 1908	1,000
The Susceptibility of Tubercle Bacilli to Modification. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) February 15, 1908...	500
Suggestions for Horse and Mule Raising in the South. Cir. 124. February 15, 1908	4,000
Osteoporosis, or Bighead of the Horse. Cir. 121. Reprint, February 17, 1908.	2,000
Experiments in Beef Production in Alabama. Bul. 103. February 28, 1908. Price 10 cents	3,700

The Federal Meat-Inspection Service. Cir. 125. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) February 29, 1908	4,500
Investigations in Animal Nutrition. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) March 4, 1908	500
The New Meat-Inspection Law and Its Bearing Upon the Production and Handling of Meats. Cir. 101. Reprint, February 19, 1908	1,000
White Diarrhea of Chicks, with Notes on Coccidiosis in Birds. Cir. 128. February 21, 1908	2,000
Direcciones Para el Uso de la Vacuna Contra la Morrina Negra. Cir. 23 (tercera revisión). February 21, 1908	2,500
A Practical Method for the Detection of Beef Fat in Lard. Cir. 132. May 23, 1908	2,500
Experiments on the Digestibility of Prickly Pear by Cattle. Bul. 106. May 28, 1908. Price 10 cents	3,800
Glanders and Farcy. Cir. 78. Reprint, June 8, 1908	1,000
Rabies and Its Increasing Prevalence. Cir. 129. Reprint, June 9, 1908	2,000
Tubercle Bacilli in Butter: Their Occurrence, Vitality, and Significance. Cir. 127. April 4, 1908	5,500
Rabies and Its Increasing Prevalence. Cir. 129. April 16, 1908	4,000
Medical Milk Commissions and the Production of Certified Milk in the United States. Bul. 104. May 5, 1908. Price 10 cents	5,000
Index-Catalogue of Medical and Veterinary Zoology. Part 20. (Authors: N to Nystrom.) Bul. 39. June 30, 1908. Price 15 cents	2,000
Stomach Worms (*Hæmonchus Contortus*) in Sheep. Cir. 102. Reprint, June 19, 1908	500
Reprint, October 12, 1908	1,000
Anthrax in Cattle, Horses, and Men. Cir. 71. Reprint, June 20, 1908	1,000
Some Unusual Host Relations of the Texas Fever Tick. Cir. 98. Reprint, June 26, 1908	500
The Fecundity of Poland China and Duroc Jersey Sows. Cir. 95. Reprint, June 27, 1908	1,000
Varieties of Cheese: Descriptions and Analysis. Bul. 105. June 27, 1908. Price, 10 cents	4,000
Necrotic Stomatitis. With Special Reference to Its Occurrence in Calves (Calf Diphtheria) and Pigs (Sore Mouth). Bul. 67. Reprint, March 10, 1908. Price 10 cents	1,000
Designs for Dairy Buildings. (Reprint from Twenty-third Annual Report of the Bureau, 1906.) Cir. 131. March 17, 1908	5,000
Tuberculosis of the Food-Producing Animals. Bul. 38. Reprint. March 17, 1908. Price 40 cents	2,000
A Review of Some Experimental Work in Pig Feeding. (Reprint from Twentieth Annual Report of the Bureau, 1906.) Reprint, March 31, 1908	1,000
A Simple Method of Keeping Creamery Records. Cir. 126. March 31, 1908	8,000
Butter Making on the Farm. Farm. Bul. 241. Reprint, July 22, 1907	20,000
Reprint, February 8, 1908	15,000
Reprint, April 11, 1908	15,000
Reprint, May 14, 1908	15,000
Incubation and Incubators. Farm. Bul. 236. Reprint, July 26, 1907	10,000
Reprint, February 10, 1908	5,000
Reprint, March 27, 1908	15,000
Reprint, May 13, 1908	15,000
The Cream Separator on Western Farms. Farm. Bul. 201. Reprint, August 9, 1907	10,000
Reprint, April 30, 1908	10,000
Meat on the Farm. Butchering, Curing, and Keeping. (Revised September, 1906.) Farm. Bul. 183. Reprint, August 10, 1907	10,000
Reprint, October 23, 1907	15,000
Reprint, March 12, 1908	10,000
Reprint, April 17, 1908	10,000
Reprint, May 13, 1908	15,000
Standard Varieties of Chickens. (Revised October, 1906.) Farm. Bul. 51.	
Reprint, August 10, 1907	15,000
Reprint, November 21, 1907	15,000
Reprint, February 4, 1908	10,000
Reprint, March 4, 1908	15,000
Reprint, April 14, 1908	20,000
Reprint, May 5, 1908	20,000

Poultry Management. Farm. Bul. 287. Reprint, August 13, 1907	20,000
Reprint, October 25, 1907	30,000
Reprint, February 7, 1908	15,000
Reprint, March 6, 1908	20,000
Reprint, March 28, 1908	20,000
Reprint, April 20, 1908	30,000
Reprint, April 25, 1908	15,000
Reprint, June 1, 1908	15,000
Care of Milk on the Farm. (Revised, September, 1905.) Farm. Bul. 63. Reprint, August 13, 1907	10,000
Reprint, December 23, 1907	10,000
Reprint, March 16, 1908	15,000
Reprint, June 29, 1908	3,500
Turkeys: Standard Varieties and Management. Farm. Bul. 200. Reprint, August 16, 1907	20,000
Reprint, March 18, 1908	20,000
Cheese Making on the Farm. Farm. Bul. 166. Reprint, August 19, 1907	10,000
Reprint, March 31, 1908	10,000
Breeds of Dairy Cattle. Farm. Bul. 106. Reprint, August 23, 1907	10,000
Reprint, February 14, 1908	10,000
Reprint, April 13, 1908	10,000
The Angora Goat. Farm. Bul. 137. Reprint, August 29, 1907	10,000
Reprint, February 20, 1908	5,000
Reprint, April 30, 1908	10,000
Hog raising in the South. Farm. Bul. 100. Reprint, August 31, 1907	15,000
Reprint, April 3, 1908	10,000
Reprint, May 18, 1908	10,000
Pig Management. Farm. Bul. 205. Reprint, August 31, 1907	10,000
Reprint, January 29, 1908	10,000
Reprint, May 13, 1908	30,000
The Dairy Herd: Its Formation and Management. Farm. Bul. 55. Reprint, September 5, 1907	10,000
Reprint, December 28, 1907	10,000
Reprint, March 21, 1908	15,000
Facts About Milk. (Revised.) Farm. Bul. 42. Reprint, September 18, 1907	15,000
Reprint, February 24, 1908	10,000
Reprint, March 27, 1908	10,000
Squab Raising. (Revised May, 1904.) Farm. Bul. 177. Reprint, September 23, 1907	10,000
Reprint, February 17, 1908	10,000
Reprint, May 13, 1908	15,000
Ducks and Geese. Standard Varieties and Management. (Revised April, 1906.) Farm. Bul. 64. Reprint, October 12, 1907	10,000
Reprint, February 17, 1908	10,000
Reprint, April 4, 1908	10,000
Reprint, June 24, 1908	5,000
Hog Cholera and Swine Plague. Farm. Bul. 24. Reprint, October 23, 1907	15,000
Reprint, April 3, 1908	15,000
Reprint, May 4, 1908	15,000
Horseshoeing. Farm. Bul. 179. Reprint, October 31, 1907	10,000
Reprint, April 6, 1908	10,000
Reprint, May 13, 1908	10,000
Dairying in the South. Farm. Bul. 151. Reprint, October 31, 1907	10,000
Reprint, June 20, 1908	5,000
Raising Sheep for Mutton. Farm. Bul. 96. Reprint, November 2, 1907	10,000
The Cattle Tick in Its Relation to Southern Agriculture. Farm. Bul. 261. Reprint, November 9, 1907	10,000
Some Essentials in Beef Production. Farm. Bul. 71. Reprint, December 23, 1907	5,000
Reprint, March 28, 1908	10,000
Conformation of Beef and Dairy Cattle. Farm. Bul. 143. Reprint, January 3, 1908	10,000
Milk Fever: Its Simple and Successful Treatment. Farm. Bul. 206. Reprint, January 4, 1908	5,000
Reprint, April 25, 1908	10,000

Texas or Tick Fever and Its Prevention. Farm. Bul. 258. Reprint, January 29, 1908	10,000
Scabies of Cattle. (Revised edition.) Farm. Bul. 152. Reprint, February 12, 1908	5,000
Reprint, April 24, 1908	10,000
Scab in Sheep. Farm. Bul. 159. Reprint, February 13, 1908	5,000
Reprint, April 29, 1908	10,000
Reprint, May 21, 1908	10,000

BUREAU OF BIOLOGICAL SURVEY.

Hawks and Owls from the Standpoint of the Farmer. Cir. 61. July 18, 1907	5,000
Reprint, March 10, 1908	1,000
Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1907. Cir. 62. July 30, 1907	5,000
Birds as Weed Destroyers. Reprint from Yearbook, 1898. Reprint, July 30, 1907	5,000
Game Commissions and Wardens. Their Appointment, Powers, and Duties. Bul. 28. August 5, 1907. Price 25 cents	1,000
The Game Warden of To-day. (Reprint from Yearbook, 1906.) August 28, 1907	3,000
Birds That Eat Scale Insects. (Reprint from Yearbook, 1906.) August 30, 1907	5,000
Cage-Bird Traffic of the United States. (Reprint from Yearbook, 1906.) September 6, 1907	3,000
Game Protection in 1906. (Reprint from Yearbook, 1906.) September 7, 1907	5,000
Birds of California in Relation to the Fruit Industry. Bul. 30. November 11, 1907. Price 20 cents	5,000
The Economic Value of the Bobwhite. (Reprint from Yearbook, 1903.) Reprint, December 17, 1907	1,500
Report of the Chief of the Bureau of Biological Survey for 1907. (From Annual Reports, 1907.) January 13, 1908	2,500
Food Habits of the Grosbeaks. Bul. 32. March 2, 1908. Price 25 cents	5,000
Two Vanishing Game Birds: The Woodcock and the Wood Duck. (Reprint from Yearbook, 1901.) Reprint, October 8, 1907	1,500
The Relation of Birds to the Cotton Boll Weevil. Bul. 29. October 8, 1907.	3,000
Reprint, February 27, 1908. Price 10 cents	1,500
An Economic Study of Field Mice (Genus *Microtus*). Bul. 31. October 29, 1907. Price 15 cents	5,000
List of Publications of the Biological Survey, 1907. Cir. 60, revised. November 5, 1907	1,800
Bird Day in the Schools. Cir. 17. Reprint, March 6, 1908	1,000
Destruction of Wolves and Coyotes, Results Obtained During 1907. Cir. 63. April 30, 1908	10,000
Destruction of the Cotton Boll Weevil by Birds in Winter. Cir. 64, June 24, 1908	3,000
Directions for the Destruction of Prairie Dogs. Cir. 32, second revised edition. June 26, 1908	10,000
How Birds Affect the Orchard. (Reprint from Yearbook, 1900.) Reprint, June 26, 1908	1,500
Some Common Birds in Their Relation to Agriculture. Farm. Bul. 54. Reprint, August 30, 1907	10,000
Reprint, February 7, 1908	10,000
Reprint, April 23, 1908	10,000
Game Laws for 1907. A Summary of the Provisions Relating to Seasons, Shipment, Sale, and License. Farm. Bul. 308. September 7, 1907	30,000
Reprint, October 16, 1907	10,000
Reprint, December 27, 1907	5,000
Reprint, February 14, 1908	10,000
Reprint, April 14, 1908	5,000
Importation of Game Birds and Eggs for Propagation. Farm. Bul. 197. Reprint, September 11, 1907	5,000
Reprint, March 21, 1908	5,000

The Relation of Coyotes to Stock Raising in the West. Farm. Bul. 226. Reprint, September 25, 1907	5,000
Reprint, May 12, 1908	5,000
Methods of Destroying Rats. Farm. Bul. 297. Reprint, November 22, 1907	10,000
Reprint, February 13, 1908	10,000
Reprint, April 23, 1908	5,000
Reprint, June 20, 1908	5,000

BUREAU OF CHEMISTRY.

Proceedings of the Twenty-Third Annual Convention of the Association of Official Agricultural Chemists, held at Washington, D. C., November 14–16, 1906. Bul. 105. July 5, 1907. Price 25 cents	1,000
Reprint, October 1, 1907	500
The Chemical Composition of Insecticides and Fungicides, with an account of the methods of analysis employed. Bul. 68. August 8, 1907. Price 5 cents	300
Methods for the Investigation of Canceling Inks and other Stamping Inks. Cir. 12, revised. Reprint, August 8, 1907	500
Report on Colors: The Solubility and Extraction of Colors and the Color Reactions of Dyed Fiber and of Aqueous and Sulphuric-acid Solutions. Cir. 35. August 15, 1907	2,500
Methods for the Examination of Maple Products. Cir. 23. Reprint, August 16, 1907	250
Coloring Matters for Foodstuffs and Methods for Their Detection. Cir. 25. Reprint, August 16, 1907	300
The Preparation of Unfermented Apple Juice. (Reprint from Yearbook, 1906.) August 27, 1907	2,000
Proceedings of the Nineteenth Annual Convention of the Association of Official Agricultural Chemists, held at Washington, D. C., October 2, 3, and 4, 1902. Bul. 73. Reprint, August 27, 1907. Price 10 cents	250
Chemical Methods for Utilizing Wood, Including Destructive Distillation, Recovery of Turpentine, Rosin, and Pulp, and the Preparation of Alcohols and Oxalic Acid. Cir. 36. August 30, 1907	3,500
Reprint, January 13, 1908	2,000
Reprint, May 1, 1908	5,000
Cassava: Its Content of Hydrocyanic Acid and Starch and Other Properties. Bul. 106. August 31, 1907. Price 5 cents	2,100
Results of Borax Experiment. Cir. 15. Reprint, September 5, 1907	500
Adulterated Drugs and Chemicals. I. Inferior Drugs and Insidious Methods of Deception. II. Rose Geranium Oil and Its Substitutes. III. Phenacetin: Methods of Analysis and Commercial Status. Bul. 80. Reprint, September 10, 1907. Price 5 cents	1,000
The Effect of Climatic Conditions on the Composition of Durum Wheat. (Reprint from Yearbook, 1906.) September 10, 1907	500
Official and Provisional Methods of Analysis, Association of Official Agricultural Chemists. As Compiled by the Committee on Revision of Methods, November 1, 1906, and Provisionally adopted by the Association. Bul. 107. September 10, 1907. Price 20 cents	1,000
Sugar-Cane Culture in the Southeast for the Manufacture of Table Sirup. Bul. 75. Reprint, September 11, 1907. Price 5 cents	300
Olive Oil and Its Substitutes. Bul. 77. Reprint, September 11, 1907. Price 10 cents	1,000
Foods and Food Adulterants. Cereals and Cereal Products. Bul. 13, Part IX. Reprint, September 20, 1907. Price 15 cents	500
Influence of Food Preservatives and Artificial Colors on Digestion and Health. II.—Salicylic Acid and Salicylates. Bul. 84, Part II. Reprint, September 24, 1907. Price 30 cents	500
Mineral Waters of the United States. Bul. 91. Reprint, September 26, 1907. Price 10 cents	500
Drug Legislation in the United States. Bul. 98. Reprint, September 27, 1907. Price 25 cents	1,000
Proceedings of the Twentieth Annual Convention of the Association of Official Agricultural Chemists, held at Washington, D. C., November 19, 20, and 21, 1903. Reprint, September 28, 1907. Price 15 cents	200
The Effect of Water on Rock Powders. Bul. 92. Reprint, October 23, 1907. Price 15 cents	2,000

Proceedings of the Twenty-first Annual Convention of the Association of Official Agricultural Chemists, held at St. Louis, Mo., September 26, 27, and 28, 1904. Bul. 90. Reprint, October 2, 1907. Price 15 cents	200
Officials Charged with the Enforcement of Food Laws in the United States and Canada. (Revised to July 1, 1907.) Cir. 16 (revised). October 9, 1907.	3,000
Organization of the Bureau of Chemistry. (Revised to July 1, 1907.) Cir. 14. October 10, 1907	3,000
Methods of Analysis Adopted by the Association of Official Agricultural Chemists, November 11, 12, and 14, 1898. Bul. 46, revised edition. October 28, 1908. Price 5 cents	250
Provisional Methods for the Analysis of Foods Adopted by the Association of Official Agricultural Chemists, November 14-16, 1901. Bul. 65. Reprint, October 31, 1907. Price 10 cents	250
Examination Papers. Cir. 34. Reprint, November 5, 1907	2,500
General Results of the Investigations Showing the Effect of Sulphurous Acid and Sulphites Upon Digestion and Health. Cir. 37. November 22, 1907.	5,000
Influence of Food Preservatives and Artificial Colors on Digestion and Health. III.—Sulphurous Acid and Sulphites. Bul. 84, Part III. December 23, 1907. Price 25 cents	1,000
Organization of the Bureau of Chemistry. (Revised to July 1, 1907.) Cir. 14. Reprint, January 13, 1908	2,000
Some Technical Methods of Testing Miscellaneous Supplies, Including Paints and Paint Materials, Inks, Lubricating Oils, Soaps, etc. Bul. 109. April 22, 1908. Price 10 cents	2,500
Commercial Feeding Stuffs of the United States: Their Chemical and Microscopical Examination. Bul. 108. April 3, 1908. Price 25 cents	3,000
Food Legislation During the Year Ended June 30, 1907. Federal Laws and Laws of States and Territories, Alabama to New Hampshire, Inclusive. Bul. 112, Part I. April 28, 1908. Price 20 cents	1,000
Food Legislation During the Year Ended June 30, 1907. Laws of States and Territories, New Jersey to Wyoming, Inclusive. Bul. 112, Part II. April 29, 1908. Price 20 cents	1,000
Report of The Chemist for 1907. (From Annual Reports, 1907.) January 28, 1908	500
The Fermenting Power of Pure Yeasts and Some Associated Fungi. Bul. 111. February 4, 1908. Price 5 cents	3,000
Extracts from the Proceedings of the Association of Official Agricultural Chemists, 1907. Cir. 38. March 14, 1908	1,600
Chemical Analysis and Composition of American Honeys, including a Microscopical Study of Honey Pollen. Bul. 110. March 16, 1908. Price 20 cents	2,500
Arsenic in Papers and Fabrics. Bul. 86. Reprint, June 25, 1908. Price 5 cents	200
Injury to Vegetation and Animal Life by Smelter Wastes. Bul. 113. May 27, 1908. Price 10 cents	2,500
Extracts from the Proceedings of the Association of Official Agricultural Chemists, 1904. Cir. 20. Reprint, June 20, 1908	300
Extracts from the Proceedings of the Association of Official Agricultural Chemists, 1906. Cir. 32. Reprint, June 20, 1908	200
Extracts from the Proceedings of the Association of Official Agricultural Chemists, 1903. Cir. 13. Reprint, June 22, 1908	200
Sorghum Sirup Manufacture. Farm. Bul. 135. Reprint, August 6, 1907	5,000
Reprint, February 24, 1908	5,000
Reprint, April 15, 1908	10,000
Industrial Alcohol: Sources and Manufacture. Farm. Bul. 268. (Revised, August 5, 1907.) Reprint, October 5, 1907	10,000
Reprint, February 13, 1908	10,000
Household Tests for the Detection of Oleomargine and Renovated Butter. Farm. Bul. 131. Reprint, October 28, 1907	5,000
Reprint, April 11, 1908	5,000
Industrial Alcohol: Uses and Statistics. Farm. Bul. 269. Reprint, February 10, 1908	5,000
Reprint, April 8, 1908	10,000
The Sugar Beet: Culture, Seed Development, Manufacture, and Statistics. (Second revised edition, September, 1901.) Farm. Bul. 52. Reprint, March 20, 1908	10,000
Reprint, May 7, 1908	15,000

BUREAU OF ENTOMOLOGY.

Harvest Mites, or "Chiggers." Cir. 77. Reprint, July 3, 1907	3,000
Note on the Occurrence of the North American Fever Tick on Sheep. Cir. 91. July 3, 1907	3,000
Papers on Deciduous-Fruit Insects and Insecticides. The Spring Canker-Worm. Bul. 68, Part II. July 6, 1907. Price 5 cents	2,000
A Brief Account of the Principal Insect Enemies of the Sugar Beet. Bul. 43. Reprint, July 10, 1907. Price 5 cents	1,000
Miscellaneous Papers. New Genera and Species of Aphelininæ, with a Revised Table of Genera. Technical Series No. 12, Part IV. (Supplement to Technical Series No. 1.) July 12, 1907. Price 5 cents	2,000
Papers on the Cotton Boll Weevil and Related and Associated Insects. An Ant Enemy of the Cotton Boll Weevil. Bul. 63, Part III. Reprint, July 12, 1907. Price 5 cents	1,000
The Fall Army Worm and Variegated Cutworm. Bul. 29, new series. Reprint, July 15, 1907. Price 5 cents	1,000
The Annual Loss Occasioned by Destructive Insects in the United States. (Reprint from Yearbook, 1904.) Reprint, July 24, 1907	2,000
The Periodical Cicada. Bul. 71. Reprint, July 24, 1907. Price 5 cents	1,000
Some Insects Injurious to the Violet, Rose, and Other Ornamental Plants. A Collection of Articles Dealing with Insects of This Class. Bul. 27, new series, revised edition. Reprint, July 30, 1907. Price 10 cents	1,000
The Cause of American Foul Brood. Cir. 94. August 1, 1907	5,000
The Spring Grain-Aphis or So-called "Green Bug." (*Toxoptera graminum* Rond.) Cir. 93. August 24, 1907	5,000
The Cranberry Spanworm; The Striped Garden Caterpillar. Bul. 66, Part III. August 31, 1907. Price 5 cents	2,000
Some Recent Studies of the Mexican Cotton Boll Weevil. (Reprint from Yearbook, 1906.) September 5, 1907	3,000
The Corn Leaf-Aphis and Corn Root-Aphis. Cir. 86. Reprint, September 13, 1907	2,000
Mites and Lice on Poultry. Cir. 92. September 25, 1907	3,000
Reprint, February 7, 1908	3,000
The San Jose or Chinese Scale. Bul. 62. Reprint, September 28, 1907. Price 25 cents	1,000
Reprint, March 26, 1908	1,000
The Most Important Step in the Control of the Boll Weevil. Cir. 95. (Revision of Cir. 56.) October 3, 1907	30,000
Lime-Sulphur Washes for the San Jose Scale. (Reprint from Yearbook, 1906.) September 6, 1907	3,000
The Colorado Potato Beetle. (*Leptinotarsa decimlineata* Say.) Cir. 87. Reprint, September 10, 1907	2,000
The Brood Diseases of Bees. Cir. 79. Reprint, September 10, 1907	5,000
The Laws in Force Against Injurious Insects and Foul Brood in the United States. Bul. 61. Reprint, September 12, 1907. Price 25 cents	1,000
Miscellaneous Papers. The More Important Aleyrodidæ Infesting Economic Plants, with Description of a New Species Infesting the Orange. Tech. Ser. 12. Part V. October 22, 1907. Price 5 cents	2,000
Information Concerning the North American Fever Tick, with notes on other species. Bul. 72. November 2, 1907. Price 15 cents	3,000
Reprint, January 7, 1908	1,000
The White Pine Weevil. Cir. 90. Reprint, December 6, 1907	3,000
Proceedings of the Eighteenth Annual Meeting of the Association of Economic Entomologists. Bul. 60. Reprint, October 3, 1907. Price 20 cents	1,000
The Principal Injurious Insects of 1906. (Reprint from Yearbook, 1906.) October 10, 1907	500
The Trumpet Leaf-Miner of the Apple. Bul. 68, Part III. October 16, 1907. Price 5 cents	2,000
The Lesser Peach Borer. Bul. 68, Part IV. October 17, 1907. Price 5 cents	2,000
Proceedings of the Nineteenth Annual Meeting of the Association of Economic Entomologists. Bul. 67. November 25, 1907. Price 20 cents	1,800
The Larger Apple-Tree Borers. Cir. 32, third revision. December 10, 1907	2,000
Reprint, June 25, 1908	3,000
The Mexican Cotton Boll Weevil (*Anthonomus grandis* Boh.) Cir. 14, second series (revision of No. 6). Reprint, December 14, 1907	250

Some Factors in the Natural Control of the Mexican Cotton Boll Weevil. Bul. 74. December 14, 1907. Price 15 cents	3,000
The Catalpa Sphinx (*Ceratomia catalpa* Bdv.). Cir. 96. December 14, 1907.	3,000
Miscellaneous Papers on Apiculture—Production and Care of Extracted Honey; Methods of Honey Testing for Bee Keepers. Bul. 75, Part I. December 19, 1907. Price 5 cents	3,000
The Tobacco Thrips, a New and Destructive Enemy of Shade-Grown Tobacco. Bul. 65. Reprint, December 28, 1907. Price 10 cents	1,000
Miscellaneous Papers on Apiculture—Wax Moths and American Foul Brood. Bul. 75, Part II. December 31, 1907. Price 5 cents	3,000
Information Concerning the North American Fever Tick, with notes on other species. Bul. 72. Reprint, January 7, 1908. Price 15 cents	1,000
The Hessian Fly (*Mayetiola* (*Cecidomyia*) *destructor* Say). Cir. 70. Reprint, January 2, 1908	3,000
Papers on Deciduous Fruit Insects and Insecticides—The Lesser Apple Worm. Bul. 68, Part V. January 9, 1908. Price 5 cents	2,000
Insects Affecting Domestic Animals; An Account of the Species of Importance in North America, with Mention of Related Forms Occurring on Other Animals. Bul. 5, new series. Reprint, January 10, 1908. Price 20 cents	500
Some Miscellaneous Results of the Work of the Bureau of Entomology. IX. An Injurious North American Species of Apion, with Notes on Related Forms. Bul. 64, Part IV. January 14, 1908. Price 5 cents	2,000
Report of the Entomologist for 1907. (From Annual Reports, 1907.) January 17, 1908	1,000
Studies of Parasites of the Cotton Boll Weevil. Bul. 73. January 23, 1908. Price 10 cents	3,000
The Apple-Tree Tent Caterpillar (*Malacosoma americana* Fab.). Cir. 98. January 28, 1908	3,000
True Clothes Moth (*Tinea pellionella* et al.). Cir. 36, second series, revised. Reprint, January 15, 1908	3,000
The White Ant (*Termes flavipes* Koll.). Cir. 50, second series, revised edition. Reprint, February 4, 1908	3,000
Root-Maggots and How to Control Them. Cir. 63, second edition. Reprint, February 4, 1908	3,000
House Ants (*Monomorium pharaonis* et al.). Cir. 34, second series, revised. February 5, 1908	5,000
The Bagworm (*Thyridopteryx ephemeraeformis* Haw.). Cir. 97. February 7, 1908	3,000
The Bedbug (*Cimex lectularius* L.). (Revised from Bul. 4, new series.) Cir. 47. Reprint, February 19, 1908	5,000
List of Publications of the Bureau of Entomology. Cir. 76, revised to March 1, 1908. February 17, 1908	3,000
The Nut Weevils. Cir. 99. Reprint, March 7, 1908	3,000
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Insect Injuries to Forest Products. (Reprint from Yearbook, 1904.) Reprint, April 16, 1908	1,000
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Some Miscellaneous Results of the Work of the Bureau of Entomology. IX. Insects Injurious to the Loco Weeds. Bul. 64, Part V. June 1, 1908. Price 5 cents	2,000
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Insects Enemies of Forest Reproduction. (Reprint from Yearbook, 1905.) Reprint, June 20, 1908	1,000
The Terrapin Scale (*Eulecanium nigrofasciatium* Pergande.) Cir. 88. Reprint, June 20, 1908	3,000
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The Sources of Arsenic in Certain Samples of Dried Hops. Bul. 121, Part IV. February 24, 1908. Price 5 cents	2,000
The Germination of Vegetable Seeds. Bul. 131, Part I. March 7, 1908. Price 5 cents	4,500
Peppermint. Bul. 90, Part III. Reprint, March 7, 1908. Price 5 cents	300
Apple Leaf-Spot Caused by Sphæropsis Malorum. Bul. 121, Part V. March 13, 1908. Price 5 cents	4,500
The Botanical History and Classification of Alfalfa. Bul. 131, Part II. March 16, 1908. Price 5 cents	2,000
The Cross-Inoculation of Fruit Trees and Shrubs with Crown-gall. Bul. 131, Part III. March 17, 1908. Price 5 cents	2,500
Reprint, June 29, 1908	10,000
Pollination of Pomaceous Fruits. (Reprint from Yearbook, 1898.) Reprint, March 23, 1908	1,000
Top Working Orchard Trees. (Reprint from Yearbook, 1902.) Reprint, March 26, 1908	1,000
The Decay of Oranges While in Transit from California. Bul. 123. April 1, 1908. Price 20 cents	5,000
Reprint, June 6, 1908	3,000
Pruning and Training Grapes. (Reprint from Yearbook, 1896.) Reprint, April 4, 1908	1,000
Barley Culture in the Northern Great Plains. Cir. 5. April 11, 1908	2,500
Dry-Land Olive Culture in Northern Africa. Bul. 125. April 11, 1908. Price 10 cents	2,000
The Improvement of Mountain Meadows. Bul. 127. April 14, 1908. Price 10 cents	8,165
Miscellaneous Papers. Bul. 121. April 18, 1908. Price 15 cents	2,500
Self-Boiled Lime-Sulphur Mixture as a Promising Fungicide. Cir. 1. April 18, 1908	4,700
Curly-Top, a Disease of the Sugar Beet. Bul. 122. April 25, 1908. Price 15 cents	2,000
The Treatment of Damping-Off in Coniferous Seedlings. Cir. 4. May 1, 1908.	3,000
The Field Treatment of Tobacco Root-Rot. Cir. 7. May 4, 1908	3,500
Some Stem Tumors or Knots on Apple and Quince Trees. Cir. 3. May 12, 1908	3,500
Reprint, June 27, 1908	8,500
The Smuts of Sorghum. Cir. 8. May 13, 1908	3,000
Recent Studies of the Olive-Tubercle Organism. Bul. 131, Part IV. May 14, 1908. Price 5 cents	1,800
An Improved Method of Separating Buckhorn From Red Clover and Alfalfa Seeds. Cir. 2. May 14, 1908	3,500
Notes on Dry Farming. Cir. 10. June 11, 1908	3,000
Egyptian Cotton in the Southwestern United States. Bul. 128. June 13, 1908. Price, 15 cents	2,500
Texas Root-Rot of Cotton: Field Experiments in 1907. Cir. 9. June 19, 1908	6,000
Planning a Cropping System. Bul. 102, Part III. Reprint, June 20, 1908. Price, 5 cents	300
The Cultivation and Handling of Goldenseal. Cir. 6. June 22, 1908	3,500
Nomenclature of the Pear. A Catalogue-Index of the Known Varieties Referred to in American Publications from 1804 to 1907. Bul. 126. June 30, 1908. Price, 30 cents	1,000
Cucumbers. Farm. Bul. 254. Reprint, July 15, 1907	10,000
Reprint, April 6, 1908	5,000
The Home Vegetable Garden. Farm. Bul. 255. Reprint, July 25, 1907	20,000
Reprint, December 26, 1907	10,000
Reprint, February 11, 1908	20,000
Reprint, April 8, 1908	20,000
Reprint, May 7, 1908	15,000
Reprint, May 27, 1908	15,000

Raspberries. Farm. Bul. 213. Reprint, July 23, 1907	10,000
Reprint, February 4, 1908	5,000
Reprint, April 14, 1908	15,000
Reprint, April 22, 1908	10,000
Alfalfa Growing. Farm. Bul. 215. Reprint, July 30, 1907	15,000
Reprint, January 8, 1908	10,000
Reprint, March 20, 1908	10,000
Reprint, April 4, 1908	15,000
Reprint, April 21, 1908	10,000
Reprint, June 15, 1908	10,000
An Example of Model Farming. Farm. Bul. 242. Reprint, September 10, 1907	10,000
Reprint, February 3, 1908	15,000
Reprint, April 21, 1908	15,000
Fungicides and Their Use in Preventing Diseases of Fruits. Farm. Bul. 243. Reprint, August 3, 1907	10,000
Reprint, April 7, 1908	10,000
Varieties of Fruits Recommended for Planting. Farm. Bul. 208. Reprint, August 6, 1907	15,000
Reprint, March 7, 1908	10,000
Reprint, April 7, 1908	15,000
Strawberries. Farm. Bul. 198. Reprint, August 6, 1907	15,000
Reprint, January 30, 1908	10,000
Reprint, April 15, 1908	15,000
Weeds; and How to Kill Them. Farm. Bul. 28. (Second revision, March, 1905.) Reprint, August 9, 1907	10,000
Reprint, October 31, 1907	10,000
Reprint, February 17, 1908	10,000
Reprint, March 28, 1908	10,000
Reprint, May 8, 1908	10,000
Tomatoes. Farm. Bul. 220. Reprint, August 10, 1907	15,000
Reprint, February 7, 1908	10,000
Reprint, April 9, 1908	15,000
Reprint, May 9, 1908	20,000
Thirty Poisonous Plants of the United States. Farm. Bul. 86. Reprint, August 12, 1907	10,000
The School Garden. Farm. Bul. 218. Reprint, August 13, 1907	10,000
Reprint, March 5, 1908	10,000
Reprint, April 18, 1908	15,000
Practical Suggestions for Fruit Growers. Farm. Bul. 161. Reprint, August 14, 1907	15,000
Reprint, March 20, 1908	10,000
Reprint, May 7, 1908	15,000
The Propagation of Plants. Farm. Bul. 157. Reprint, August 16, 1907	10,000
Reprint, March 24, 1908	10,000
Comparative Value of Whole Cotton Seed and Cotton-Seed Meal in Fertilizing Cotton. Farm. Bul. 286. Reprint, August 16, 1907	10,000
Reprint, September 26, 1907	10,000
Reprint, October 19, 1907	20,000
The Advantage of Planting Heavy Cotton Seed. Farm. Bul. 285. Reprint, August 16, 1907	10,000
Reprint, September 27, 1907	10,000
Reprint, October 11, 1907	10,000
Essential Steps in Securing an Early Crop of Cotton. Farm. Bul. 217. Reprint, August 21, 1907	10,000
Reprint, February 18, 1908	5,000
Reprint, April 8, 1908	10,000
Reprint, April 25, 1908	15,000
Corn Growing. Farm. Bul. 199. Reprint, August 21, 1907	20,000
Reprint, January 4, 1908	10,000
Reprint, April 11, 1908	20,000
Reprint, May 15, 1908	20,000
A Method of Eradicating Johnson Grass. Farm. Bul. 279. Reprint, August 21, 1907	5,000
Reprint, November 22, 1907	5,000
Reprint, February 11, 1908	10,000

Beans. Farm. Bul. 289. Reprint, August 21, 1907	20,000
The Home Fruit Garden: Preparation and Care. Farm. Bul. 154. Reprint, August 23, 1907	15,000
Reprint, March 27, 1908	15,000
Reprint, May 15, 1908	10,000
Sea Island Cotton; Its Culture, Improvement, and Diseases. Farm. Bul. 302. August 27, 1907	10,000
Reprint, October 11, 1907	10,000
Beautifying the Home Grounds. Farm. Bul. 185. Reprint, August 29, 1907	10,000
Reprint, December 20, 1907	10,000
Reprint, March 14, 1908	15,000
Reprint, May 2, 1908	15,000
Potato Diseases and Their Treatment. Farm. Bul. 91. Reprint, August 31, 1907	10,000
Reprint, January 6, 1908	5,000
Reprint, February 21, 1908	10,000
Reprint, April 21, 1908	10,000
The Apple and How to Grow It. Farm. Bul. 113. Reprint, September 3, 1907	10,000
Reprint, December 23, 1907	10,000
Reprint, February 27, 1908	10,000
Reprint, April 21, 1908	15,000
Annual Flowering Plants. Farm. Bul. 195. Reprint, September 6, 1907	10,000
Reprint, January 28, 1908	5,000
Reprint, March 11, 1908	15,000
Reprint, April 11, 1908	15,000
Reprint, May 4, 1908	15,000
The Prevention of Stinking Smut of Wheat and Loose Smut of Oats. Farm. Bul. 250. Reprint, September 6, 1907	10,000
Reprint, February 3, 1908	10,000
The Lawn. Farm. Bul. 248. Reprint, September 6, 1907	15,000
Reprint, January 31, 1908	10,000
Reprint, May 16, 1908	15,000
Seed of Red Clover and Its Impurities. Farm. Bul. 260. Reprint, September 7, 1907	10,000
Reprint, February 3, 1908	10,000
Reprint, May 4, 1908	10,000
Winter Forage Crops for the South. Farm. Bul. 147. Reprint, September 10, 1907	10,000
Reprint, March 23, 1908	10,000
The Renovation of Worn-Out Soils. Farm. Bul. 245. Reprint, September 10, 1907	10,000
Reprint, Feb. 3, 1908	10,000
Reprint, April 7, 1908	10,000
Reprint, May 19, 1908	15,000
The Germination of Seed Corn. Farm. Bul. 253. Reprint, September 10, 1907	15,000
Reprint, April 7, 1908	10,000
Reprint, May 21, 1908	15,000
Alfalfa Seed. Farm. Bul. 194. Reprint September 10, 1907	10,000
Reprint, February 13, 1908	10,000
Reprint, April 27, 1908	10,000
The Home Vineyard, with Special Reference to Northern Conditions. Farm. Bul. 156. Reprint, September 14, 1907	10,000
Reprint February 17, 1908	5,000
Reprint, April 8, 1908	10,000
Leguminous Crops For Green Manuring. Farm. Bul. 278. Reprint, September 17, 1907	20,000
Reprint, February 13, 1908	20,000
Dodder in Relation to Farm Seeds. Farm. Bul. 306. September 24, 1907	15,000
Reprint, January 4, 1908	10,000
Reprint, May 2, 1908	10,000
Reprint, May 19, 1908	15,000
Sweet Potatoes. Farm. Bul. 129. Reprint, September 24, 1907	10,000
Reprint, March 20, 1908	10,000
Growing and Curing Hops. Farm. Bul. 304. September 25, 1907	15,000
Reprint, November 20, 1907	15,000

Some Important Grasses and Forage Plants for the Gulf Coast Region. Farm. Bul. 300. Reprint, October 2, 1907	10,000
Reprint, February 13, 1908	10,000
Canadian Field Peas. Farm. Bul. 224. Reprint, October 21, 1907	5,000
Reprint, March 14, 1908	5,000
Home Manufacture and Use of Unfermented Grape Juice. Farm. Bul. 175. Reprint, October 21, 1907	10,000
Reprint, April 3, 1908	5,000
Pineapple Growing. Farm. Bul. 140. Reprint, October 22, 1907	5,000
Reprint, May 12, 1908	5,000
Roselle: Its Culture and Uses. Farm. Bul. 307. October 24, 1907	10,000
Reprint, February 5, 1908	5,000
Peach Growing for Market. Farm. Bul. 33. Reprint, October 7, 1907	10,000
Reprint, May 7, 1908	10,000
Rice Culture in the United States. Farm. Bul. 110. Reprint, October 11, 1907	5,000
Reprint, April 4, 1908	5,000
The Cultivation of Mushrooms. Farm. Bul. 204. Reprint, October 26, 1907	10,000
Reprint, April 23, 1908	10,000
Fungous Diseases of the Cranberry. Farm. Bul. 221. Reprint, October 29, 1907	10,000
The Production of Good Seed Corn. Farm. Bul. 229. Reprint, November 2, 1907	20,000
Reprint, April 10, 1908	20,000
Reprint, May 19, 1908	20,000
Rape as a Forage Crop. Farm. Bul. 164. Reprint, November 6, 1907	5,000
Reprint, March 28, 1908	5,000
Citrus Fruit Growing in the Gulf States. Farm. Bul. 238. Reprint, November 16, 1907	5,000
Reprint April 9, 1908	5,000
Saccharine Sorghums for Forage. Farm. Bul. 246. Reprint, November 19, 1907	10,000
Reprint, April 22, 1908	10,000
Pruning. Farm. Bul. 181. Reprint, November 23, 1907	10,000
Reprint, February 20, 1908	10,000
Reprint, April 29, 1908	15,000
A Successful Southern Hay Farm. Farm. Bul. 312. November 26, 1907	15,000
Reprint, April 16, 1908	10,000
A Successful Alabama Diversification Farm. Farm. Bul. 310. December 12, 1907	10,000
Reprint, March 21, 1908	5,000
Reprint, May 2, 1908	10,000
A Method of Breeding Early Cotton to Escape Boll-Weevil Damage. Farm. Bul. 314. February 8, 1908	20,000
Reprint, June 15, 1908	5,000
Harvesting and Storing Corn. Farm. Bul. 313. December 21, 1907	30,000
Reprint, April 16, 1908	20,000
Diversified Farming Under the Plantation System. Farm. Bul. 299. Reprint, January 4, 1908	5,000
Reprint, March 18, 1908	5,000
Reprint, May 2, 1908	10,000
Weeds Used in Medicine. Farm. Bul. 188. Reprint, January 4, 1908	10,000
Reprint, April 20, 1908	10,000
A Profitable Tenant Dairy Farm. Farm. Bul. 280. Reprint, January 6, 1908	10,000
Reprint, April 15, 1908	10,000
Cost of Filling Silos. Farm. Bul. 292. Reprint, January 8, 1908	10,000
Progress in Legume Inoculation. Farm. Bul. 315. January 11, 1908	15,000
Reprint, March 23, 1908	10,000
Forage-Crop Practices in Western Oregon and Western Washington. Farm. Bul. 271. Reprint, January 21, 1908	5,000
Reprint, February 11, 1908	5,000
Farm Practice in the Columbia Basin Uplands. Farm. Bul. 294. Reprint, January 28, 1908	5,000
Reprint, April 18, 1908	10,000

Celery. Farm. Bul. 282. Reprint, January 31, 1908	10,000
Reprint, April 3, 1908	10,000
Broom Corn. Farm. Bul. 174. Reprint, February 10, 1908	5,000
Reprint, May 12, 1908	5,000
Pearl Millet. Farm. Bul. 168. Reprint, February 17, 1908	5,000
Lessons from the Grain-Rust Epidemic of 1904. Farm. Bul. 219. Reprint, February 17, 1908	5,000
Home-Grown Tea. Farm. Bul. 301. Reprint, February 21, 1908	5,000
Cranberry Culture. Farm. Bul. 176. Reprint, February 25, 1908	5,000
The Soy Bean as a Forage Crop. Farm. Bul. 58. Reprint, March 4, 1908	5,000
Reprint, May 8, 1908	10,000
Cassava. Farm. Bul. 167. Reprint, April 4, 1908	10,000
A Successful Hog and Seed-Corn Farm. Farm. Bul. 272. Reprint, October 12, 1908	20,000
Reprint, April 3, 1908	15,000
Cowpeas. Farm. Bul. 318. April 4, 1908	30,000
Spraying for Cucumber and Melon Diseases. Farm. Bul. 231. Reprint, April 6, 1908	5,000
Reprint, May 6, 1908	10,000
Demonstration Work in Cooperation with Southern Farmers. Farm. Bul. 319. April 7, 1908	30,000
Okra: Its Culture and Uses. Farm. Bul. 232. Reprint, April 15, 1908	5,000
Evaporation of Apples. Farm. Bul. 291. Reprint, May 1, 1908	10,000
Clover Farming on the Sandy Jack-Pine Lands of the North. Farm. Bul. 323. May 9, 1908	10,000
Small Farms in the Corn Belt. Farm. Bul. 325. May 9, 1908	20,000
Building Up a Run-Down Cotton Plantation. Farm. Bul. 326. May 20, 1908	20,000
Sweet Potatoes. Farm. Bul. 324. May 26, 1908	20,000
Milo as a Dry-Land Grain Crop. Farm. Bul. 322. June 3, 1908	10,000
Millets. Farm. Bul. 101. Reprint, October 23, 1907	5,000
Reprint, March 10, 1908	5,000
Meadows and Pastures: Formation and Cultivation in the Middle Eastern States. (Edition of March, 1904.) Farm. Bul. 66. Reprint, August 1, 1907	5,000
Reprint, December 11, 1907	5,000
Reprint, March 13, 1908	5,000
Reprint, May 8, 1908	10,000
Southern Forage Plants. Farm. Bul. 102. Reprint, October 9, 1907	10,000
Reprint, March 6, 1908	10,000
Cattle Ranges of the Southwest. Farm. Bul. 72. Reprint, October 21, 1907	5,000
Reprint, April 6, 1908	5,000
Thirty Poisonous Plants of the United States. Farm. Bul. 86. Reprint, February 3, 1908	5,000
Reprint, March 31, 1908	10,000
The Farmer's Interest in Good Seed. Farm. Bul. 111. Reprint, March 11, 1908	10,000
Reprint, October 5, 1908	10,000
Grape Growing in the South. Farm. Bul. 118. Reprint, October 11, 1907	10,000
Reprint, May 15, 1908	5,000
Peach Growing for Market. Farm. Bul. 33. Reprint, March 6, 1908	10,000

DIVISION OF PUBLICATIONS.

Monthly List of Publications:	
June, 1907. Pp. 4. Domestic	245,000
June, 1907. Pp. 4. Foreign	4,000
July, 1907. Pp. 4. Domestic	230,000
July, 1907. Pp. 4. Foreign	4,000
August, 1907. Pp. 4. Domestic	235,000
August, 1907. Pp. 4. Foreign	4,000
September, 1907. Pp. 4. Domestic	235,000
September, 1907. Pp. 4. Foreign	4,000
October, 1907. Pp. 4. Domestic	235,000
October, 1907. Pp. 4. Foreign	4,000
November, 1907. Pp. 4. Domestic	235,000
November, 1907. Pp. 4. Foreign	4,000

Monthly List of Publications—Continued.	
December, 1907, and January, 1908. Pp. 4. Domestic	235,000
January, 1908. Pp. 4. Foreign	4,000
February, 1908. Pp. 4. Foreign	5,000
February–March, 1908. Pp. 4. Domestic	215,000
March, 1908. Pp. 3. Foreign	4,000
April, 1908. Pp. 4. Foreign	5,000
April–May, 1908. Pp. 4. Domestic	221,000
Publications for Sale. Cir. 3. July 19, 1907	3,500
Reprint, October 29, 1907	5,000
Reprint, February 21, 1908	5,000
A Directory for Farmers. (Corrected to April 1, 1907.) (Reprinted from Yearbook, 1906.) August 5, 1907	10,000
Publications for Free Distribution. Cir. 2. (Revised to August 17, 1907)	10,000
Revised to December 15, 1907. January 17, 1908	10,000
Farmers' Bulletin Subject Index. (Revised to include Bulletin 300.) Cir. 4. December 13, 1907	8,000
Reprint, June 9, 1908	1,500
Food and Drugs Index. Cir. 5. March 23, 1908	1,500
Index to Farmers' Bulletins Nos. 1–250. Bul. 8. November 4, 1907. Price 15 cents	1,000
Reprint, March 30, 1908	1,000
Report of the Editor for 1907. (From Annual Reports, 1907.) February 10, 1908	1,000
Organization of Department of Agriculture, 1908. (Revised to January 1, 1908.) Cir. 1. April 7, 1908	3,000
Practical Suggestions for Farm Buildings. Farm. Bul. 126. Reprint, August 27, 1907	10,000
Reprint, January 4, 1908	5,000
Reprint, February 11, 1908	10,000
Reprint, April 14, 1908	10,000
Reprint, May 15, 1908	10,000
Asparagus Culture. Farm. Bul. 61. Reprint, October 2, 1907	10,000
Reprint, March 16, 1908	10,000
Suggestions to Southern Farmers. Farm. Bul. 98. Reprint, October 11, 1907.	10,000
Reprint, March 14, 1908	10,000
Reprint, June 20, 1908	5,000
Marketing Farm Produce. Farm. Bul. 62. Reprint, October 31, 1907	10,000
Reprint, February 20, 1908	10,000
Reprint, May 15, 1908	10,000
Clearing New Land. Farm. Bul. 150. Reprint, November 16, 1907	5,000
Reprint, March 26, 1908	5,000

OFFICE OF PUBLIC ROADS.

Public Roads of Tennessee: Mileage and Expenditures in 1904. Cir. 48. Reprint, July 10, 1907	2,000
The Corrosion of Iron. Bul. 30. July 22, 1907. Price 10 cents	5,000
Practical Road Building in Madison County, Tennessee. (Reprint from Yearbook, 1904.) Reprint, August 6, 1907	3,000
Examination and Classification of Rocks for Road Building, Including the Physical Properties of Rocks with Reference to Their Mineral Composition and Structure. Bul. 31. August 8, 1907. Price 15 cents	4,300
Object-Lesson Roads. (Reprint from Yearbook, 1906.) September 3, 1907.	4,000
Public-Road Mileage, Revenues, and Expenditures in the United States in 1904. Bul. 32. September 6, 1907. Price 15 cents	8,800
Building Sand-Clay Roads in Southern States. (Reprint from Yearbook, 1904.) Reprint, September 21, 1907	3,000
Publications of the Office of Public Roads. Cir. 88. October 16, 1907	400
Revised, April 9, 1908	700
Report of the Director of the Office of Public Roads for 1907. (From Annual Reports, 1907.) January 13, 1908	600
Progress Reports of Experiments with Dust Preventives. Cir. 89. April 20, 1908	10,000
Tar and Oil for Road Improvement; Report of Progress of Experiments at Jackson, Tenn. Cir. 47. Reprint, June 20, 1908	1,000

Cement Mortar and Concrete: Preparation and Use for Farm Purposes. Farm. Bul. 235. Reprint, July 31, 1907	15,000
Reprint, January 28, 1908	15,000
Reprint, April 18, 1908	20,000
Good Roads for Farmers. Farm. Bul. 95. Reprint, September 5, 1907	15,000
Reprint, January 3, 1908	10,000
Reprint, February 15, 1908	15,000
Reprint, March 31, 1908	15,000
Reprint, April 23, 1908	15,000
Reprint, May 12, 1908	15,000
The Corrosion of Fence Wire. Farm. Bul. 239. Reprint, October 29, 1907	10,000
Reprint, April 11, 1908	10,000
Reprint, May 23, 1908	15,000
Sand-Clay and Burnt-Clay Roads. Farm. Bul. 311. December 7, 1907	30,000
The Use of the Split-log Drag on Earth Roads. Farm. Bul. 321. April 18, 1908	30,000
Reprint, May 16, 1908	20,000

BUREAU OF SOILS.

Reclamation of Alkali Land in Salt Lake Valley, Utah. Bul. 43. July 6, 1907. Price 10 cents	2,500
Reprint, March 16, 1908	300
Reclamation of Alkali Soils at Billings, Montana. Bul. 44. July 10, 1907. Price 10 cents	2,500
Reclamation of White-Ash Lands Affected with Alkali at Fresno, California. Bul. 42. July 27, 1907. Price 10 cents	2,500
The Use of Soil Surveys. (Reprint from Yearbook, 1906.) August 8, 1907	1,000
Improvement of Virginia Fire-Cured Tobacco. Bul. 46. August 7, 1907. Price 10 cents	2,500
Alkali Soils of the United States. A Review of Literature and Summary of Present Information. Bul. 35. Reprint, August 12, 1907. Price 25 cents	500
Reprint, March 17, 1908	300
The Moisture Equivalents of Soils. Bul. 45. September 7, 1907. Price 10 cents	2,500
Reclamation of Alkali Soils. Bul. 34. Reprint, September 20, 1907. Price 10 cents	500
The Action of Water and Aqueous Solution upon Soil Phosphates. Bul. 41. Reprint, September 18, 1907. Price 10 cents	500
The Action of Water and Aqueous Solutions upon Soil Carbonates. Bul. 49. November 1, 1907. Price 10 cents	2,500
Certain Organic Constituents of Soil in Relation to Soil Fertility. Bul. 47. November 7, 1907. Price 10 cents	2,500
Report of the Chief of the Bureau of Soils for 1907. (From Annual Reports, 1907.) January 29, 1908	100
Moisture Content and Physical Condition of Soils. Bul. 50. February 1, 1908. Price 15 cents	2,500
Further Studies on the Properties of Unproductive Soils. Bul. 36. Reprint, February 28, 1908. Price 15 cents	500
Fertility of Soils as Affected by Manures. Bul. 48. March 21, 1908. Price 10 cents	2,500
Reclamation of Alkali Lands in Egypt, as Adapted to Similar Work in the United States. Bul. 21. Reprint, March 28, 1908. Price 15 cents	300
Absorption of Vapors and Gases by Soils. Bul. 51. April 17, 1908. Price 10 cents	2,500
Soil Fertility. An Address Delivered Before the Rich Neck Farmers' Club, of Queen Anne County, Maryland. Farm. Bul. 257. Reprint, August 14, 1907	15,000
Reprint, March 23, 1908	10,000
Reprint, May 19, 1908	10,000
Methods of Curing Tobacco. (Second revised edition.) Farm. Bul. 60. Reprint, October 15, 1907	15,000
Reprint, March 10, 1908	10,000
The Culture of Tobacco. Farm. Bul. 82. Reprint, October 18, 1907	10,000
Reprint, March 10, 1908	10,000

Management of Soils to Conserve Moisture, with Special Reference to Semiarid Conditions. Farm. Bul. 266. Reprint, October 24, 1907	15,000
Reprint, November 8, 1907	10,000
Reprint, March 10, 1908	15,000
Reprint, May 8, 1908	15,000
Tobacco Soils. Farm. Bul. 83. Reprint, December 28, 1907	5,000
Reprint, March 25, 1908	10,000

BUREAU OF STATISTICS.

Crop Reporter:	
Vol. 9, No. 7. (July, 1907)	120,000
Vol. 9, No. 8. (August, 1907)	120,000
Vol. 9, No. 9. (September, 1907)	130,000
Vol. 9, No. 10. (October, 1907)	130,000
Vol. 9, No. 11. (November, 1907)	130,000
Vol. 9, No. 12. (December, 1907)	132,000
Vol. 9, No. 12. Supplement. (December, 1907)	132,500
Vol. 10. No. 1. (January, 1908)	136,000
Vol. 10, No. 2. (February, 1908)	125,000
Vol. 10, No. 3. (March, 1908)	133,000
Vol. 10, No. 4. (April, 1908)	133,000
Vol. 10, No. 5. (May, 1908)	135,000
Vol. 10, No. 6. (June, 1908)	135,000
Agricultural Statistics, 1906. Principal Crops and Farm Animals, Transportation Rates, Exports and Imports of the United States, and International Trade in Agricultural Products. (Reprint from Yearbook, 1906.) August 5, 1907	10,000
Freight Costs and Market Values. (Reprint from Yearbook, 1906.) August 24, 1907	3,000
Reprint, February 27, 1908	500
Foreign Restrictions on American Meat. (Reprint from Yearbook, 1906.) September 16, 1907	3,000
Trade with Noncontiguous Possessions in Farm and Forest Products, 1904–1906. Bul. 54. October 4, 1907. Price 10 cents	5,000
Imports of Farm and Forest Products, 1904–1906, by Countries from which Consigned. Bul. No. 52. October 5, 1907. Price 10 cents	5,000
Exports of Farm and Forest Products, 1904–1906, by Countries to which Consigned. Bul. 53. October 19, 1907. Price 10 cents	5,000
Ocean Freight Rates and the Conditions Affecting Them. Bul. 67. October 31, 1907. Price 10 cents	5,000
Reprint, December 4, 1907	1,000
Norway, Sweden, and Russia as markets for Packing-House Products; Imports from Principal Countries, 1895–1904. Bul. 41. Reprint, November 14, 1907. Price 5 cents	500
Meat in Foreign Markets, Tariffs of Fourteen Importing Nations, and Countries of Surplus. Bul. 39. Reprint, November 19, 1907. Price 5 cents	500
Wheat Crops of the United States, 1866–1906. Bul. 57. November 26, 1907. Price 10 cents	4,500
Corn Crops of the United States, 1866–1906. Bul. 56. November 27, 1907. Price 10 cents	4,500
Oat Crops of the United States, 1866–1906. Bul. 58. November 30, 1907. Price 10 cents	4,500
Barley Crops of the United States, 1866–1906. Bul. 59. December 6, 1907. Price 10 cents	4,500
Report of the Acting Chief of the Bureau of Statistics for 1907. (From Annual Reports, 1907.) January 20, 1908	1,000
Costs of Hauling Crops from Farms to Shipping Points. Bul. 49. Reprint, January 22, 1908. Price 10 cents	5,000
Reprint, June 30, 1908. Price 10 cents	2,000
Hay Crops of the United States, 1866–1906. Bul. 63. January 23, 1908. Price 10 cents	4,500
Meat Supply and Surplus, with Consideration of Consumption and Exports. Bul. 55. October 25, 1907. Price 15 cents	5,000
Reprint, November 19, 1907	2,500
Meat Animals and Packing-House Products Imported into Eleven Principal Countries, 1895–1904. Bul. 40. Reprint, November 16, 1907. Price 5 cents	500

Hops in Principal Countries: Their Supply, Foreign Trade, and Consumption, with Statistics of Beer Brewing. Bul. 50. Reprint, February 3, 1908. Price 15 cents	500
Cereal Production of Europe. Bul. 68. March 18, 1908. Price 10 cents	4,500
European Grain Trade. Bul. 69. March 20, 1908. Price 10 cents	4,500
Russia's Wheat Trade. Bul. 65. March 21, 1908. Price 15 cents	4,500
Potato Crops of the United States, 1866–1906. Bul. 62. June 8, 1908. Price 10 cents	4,500
Buckwheat Crops of the United States, 1866–1906. Bul. 61. June 15, 1908. Price 5 cents	4,500
Russian Wheat and Wheat Flour in European Markets. Bul. 66. June 24, 1908. Price 15 cents	4,000
Rye Crops of the United States, 1866–1906. Bul. 60. June 24, 1908. Price 10 cents	4,500

WEATHER BUREAU.

Monthly Weather Review (a summary by months of weather conditions throughout the United States, based upon reports of nearly 3,000 regular and voluntary observers). Quarto, price, 20 cents; $2.50 per year.	
Vol. XXXV. No. 5. May, 1907	4,900
Vol. XXXV. No. 6. June, 1907	4,900
Vol. XXXV. No. 7. July, 1907	4,900
Vol. XXXV. No. 8. August, 1907	4,900
Vol. XXXV. No. 9. September, 1907	4,900
Vol. XXXV. No. 10. October, 1907	4,750
Vol. XXXV. No. 11. November, 1907	4,750
Vol. XXXV. No. 12. December, 1907	4,750
Vol. XXXVI. No. 1. January, 1908	4,750
Vol. XXXVI. No. 2. February, 1908	4,800
Vol. XXXVI. No. 3. March, 1908	4,800
Vol. XXXVI. No. 4. April, 1908	4,800
National Weekly Weather Bulletin, reporting temperature and rainfall, with a summary of weather conditions by sections throughout the United States.	
Bulletin 16, July 1, 1907	2,200
Bulletin 17, July 8, 1907	2,200
Bulletin 18, July 15, 1907	2,200
Bulletin 19, July 22, 1907	2,200
Bulletin 20, July 29, 1907	2,200
Bulletin 21, August 5, 1907	2,200
Bulletin 22, August 12, 1907	2,200
Bulletin 23, August 19, 1907	2,200
Bulletin 24, August 26, 1907	2,200
Bulletin 25, September 2, 1907	2,200
Bulletin 26, September 9, 1907	2,200
Bulletin 27, September 16, 1907	2,200
Bulletin 28, September 23, 1907	2,200
Bulletin 29, September 30, 1907	2,200
Bulletin 30, November, 1907	2,600
Bulletin 31, December, 1907	2,650
Bulletin No. 1, January, 1908	2,650
Bulletin 2, February, 1908	2,650
Bulletin 3, March, 1908	2,675
Bulletin 4, April 13, 1908	2,300
Bulletin 5, April 20, 1908	2,300
Bulletin 6, April 27, 1908	2,300
Bulletin 7, May 4, 1908	2,300
Bulletin 8, May 11, 1908	2,450
Bulletin 9, May 18, 1908	2,450
Bulletin 10, May 25, 1908	2,500
Bulletin 11, June 1, 1908	2,500
Bulletin 12, June 8, 1908	2,500
Bulletin 13, June 15, 1908	2,500
Bulletin 14, June 22, 1908	2,250
Bulletin 15, June 29, 1908	2,250

Snow and Ice Bulletins:	
December 3, 1907	1,200
December 10, 1907	1,200
December 17, 1907	1,250
December 24, 1907	1,280
January 2, 1908	1,250
January 14, 1908	1,300
January 21, 1908	1,300
January 28, 1908	1,300
February 4, 1908	1,350
February 11, 1908	1,350
February 18, 1908	1,350
February 25, 1908	1,350
March 3, 1908	1,450
March 10, 1908	1,550
March 17, 1908	1,550
March 24, 1908	1,580
March 31, 1908	1,550
Daily Weather Map (showing weather conditions throughout the United States and giving forecasts of probable changes):	
July, 1907	39,745
August, 1907	39,747
September, 1907	39,748
October, 1907	41,247
November, 1907	41,243
December, 1907	41,245
January, 1908	41,453
February, 1908	41,455
March, 1908	41,452
April, 1908	39,547
May, 1908	39,548
June, 1908	39,548
New Problems of the Weather. (Reprint from Yearbook, 1906.) August 30, 1907	200
Reprint, October 26, 1907	500
Report of the Chief of the Weather Bureau for 1907. (W. B. No. 379.) December 11, 1907	3,000
Bulletin of the Mount Weather Observatory. Vol. I, part 1. (W. B. No. 381.) January 12, 1908	1,200
Bulletin of the Mount Weather Observatory. Vol. I, part 2. (W. B. No. 388.) April 23, 1908	1,200
Meteorological Chart of the Great Lakes. Summary for the season of 1906, No. 2, 1906. (W. B. No. 375.) Price, 10 cents	2,000
Meteorological Chart of the Great Lakes, No. 1, 1907. (W. B. No. —.) Price 10 cents	2,500
Protection of Food Products from Injurious Temperatures. Farm. Bul. 125. Reprint, August 22, 1907	5,000
Reprint, January 31, 1908	5,000
Reprint, April 4, 1908	5,000
Notes on Frost. Farm. Bul. 104. Reprint, September 11, 1907	5,000
Reprint, February 14, 1908	5,000
Reprint, April 10, 1908	5,000
Reprint, June 15, 1908	5,000

APPENDIX B.

REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING THE FISCAL YEAR ENDED JUNE 30, 1908, THE PUBLICATION OF WHICH IS PROVIDED FOR BY LAW.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that Bureau specially charged with such work, and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this Division. A list of Weather Bureau publications is given in separate tables.]

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908.

	Received.	Distributed.[a]
Miscellaneous publications on hand July 1, 1907, 1,198,653		577,091
Report of the Division of Accounts and Disbursements, 1907	200	200
Report of the appointment clerk, 1907	900	900
OFFICE OF THE SOLICITOR.		
Report of the Solicitor, 1907	1,500	1,500
Circular No. 1	1,000	1,000
Circular No. 2	1,000	1,000
Circular No. 3	500	500
Circular No. 4	1,000	700
Circular No. 5	500	500
Laws Applicable to the U. S. Department of Agriculture	1,000	1,000
BUREAU OF ANIMAL INDUSTRY.		
Report of Chief, 1906	300	107
Report of Chief, 1907	3,000	3,000
Bulletin No. 38 (reprint)	2,000	1,881
Bulletin No. 39, part 18	2,000	1,700
Bulletin No. 39, part 19	2,000	1,700
Bulletin No. 67 (reprint)	1,000	77
Bulletin No. 88	5,000	4,458
Bulletin No. 93	5,000	4,516
Bulletin No. 96	1,000	1,323
Bulletin No. 99	5,000	5,238
Bulletin No. 101	1,600	1,600
Bulletin No. 102	3,500	3,187
Bulletin No. 103	3,700	3,700
Bulletin No. 104	5,000	5,000
Bulletin No. 105	4,000	1,337
Bulletin No. 106	3,200	3,043
Circular No. 23 (third edition)	15,000	14,000
Circular No. 23 (third revision), Spanish edition	2,500	2,300
Circular No. 31 (second revision)	12,600	10,200
Circular No. 63 (reprint)	1,000	300
Circular No. 64 (reprint)	1,000	581
Circular No. 66 (reprint)	1,000	93
Circular No. 69 (reprint)	2,000	700
Circular No. 70 (reprint)	2,000	2,000
Circular No. 78 (reprint)	1,000	634
Circular No. 84 (reprint)	500	500
Circular No. 89 (reprint)	2,000	1,700
Circular No. 93	1,500	500
Circular No. 97	41,000	15,830
Circular No. 98	500	10
Circular No. 101	1,000	715
Circular No. 102	1,500	500
Circular No. 104	500	301
Circular No. 105	500	500
Circular No. 106	6,000	6,275
Circular No. 107	2,000	2,531
Circular No. 108	1,000	425
Circular No. 109	1,000	540
Circular No. 110	5,000	2,508
Circular No. 112	6,000	5,875

[a] Where the number distributed is greater than the number received, the difference is accounted for by the number on hand at the beginning of the year.

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
BUREAU OF ANIMAL INDUSTRY—continued.		
Circular No. 113	25,500	23,300
Circular No. 114	15,000	14,616
Circular No. 115	3,500	2,007
Circular No. 116	2,500	2,107
Circular No. 117	7,500	7,184
Circular No. 118	9,800	9,800
Circular No. 119	5,500	3,020
Circular No. 120	3,500	2,600
Circular No. 121	2,000	1,250
Circular No. 122	2,000	1,804
Circular No. 123	2,000	1,720
Circular No. 124	4,000	3,200
Circular No. 125	4,500	4,500
Circular No. 126	8,000	3,150
Circular No. 127	5,500	4,763
Circular No. 128	2,500	2,000
Circular No. 129	6,000	6,000
Circular No. 131	5,000	3,792
Circular No. 132	2,500	2,500
Twenty-third Annual Report, 1906	5,000	3,946
Reprints from Twenty-third Annual Report, 1906:		
The Danish Hog Industry	1,000	433
The Susceptibility of Tubercle Bacilli	500	105
Investigation in Animal Nutrition	500	500
Press Bulletin No. 11	2,000	2,000
Press Bulletin No. 12	6,000	6,000
Press Bulletin No. 13	1,200	1,200
Press Bulletin No. 14	4,175	4,175
Notice Regarding Interstate Movement of Cattle and Swine Which are Affected with Tuberculosis, Nov. 6, 1907	10,000	10,000
Notice Regarding Interstate Movement of Horses, Mules, and Asses Affected with Glanders, Oct. 9, 1907	10,000	10,000
Meat Inspection Rulings—2 A	5,000	5,000
Meat Inspection Rulings—3 A	7,500	5,000
Special Report on Diseases of the Horse, 1907	5,000	2,400
Osteoporosis, or Bighead (reprint from Special Report on Diseases of the Horse, 1907)	10,000	10,000
Publications of Interest to Dairymen, Oct. 19, 1907	2,000	2,000
Publications of Interest to Dairymen, March 19, 1908	5,000	5,000
Publications of Interest to Dairymen, February 5, 1908	1,000	1,000
C-158	4,500	4,500
Service Announcements, July 15, 1907	3,300	3,300
Service Announcements, August 12, 1907	3,500	3,500
Service Announcements, August 15, 1907	501	501
Service Announcements, September, 1907	3,500	3,500
Service Announcements, October, 1907	3,500	3,500
Service Announcements, November, 1907	3,500	3,500
Service Announcements, December, 1907	3,500	3,500
Service Announcements, January, 1908	3,500	3,500
Service Announcements, February, 1908	3,500	3,500
Service Announcements, March, 1908	3,500	3,500
Service Announcements, April, 1908	3,500	3,500
Service Announcements, May, 1908	3,500	3,500
Service Announcements, June, 1908	3,500	3,500
Index to Service Announcements	1,000	1,000
Amendment No. 1 to Order 136	1,500	900
Amendment No. 2 to Order 136	1,000	500
Order 137	2,000	3,176
Amendment No. 2 to Order 137	2,500	2,480
Amendment No. 9 to Order 137	1,000	685
Amendment No. 10 to Order 137	8,000	6,020
Amendment No. 1 to Order 142	2,000	2,000
Amendment No. 2 to Order 142	1,000	700
Amendment No. 3 to Order 142	3,000	1,000
Amendment No. 1 to Order 143	10,500	7,214
Amendment No. 2 to Order 143	10,000	3,628
Amendment No. 3 to Order 143	7,500	5,000
Order 144, Rule 1, revision 2	10,000	6,000
Amendment No. 1 to Order 144	5,000	5,000
Amendment No. 2 to Order 144	7,500	4,200
Amendment No. 3 to Order 144	7,500	3,080
Amendment No. 4 to Order 144	7,500	4,027
Amendment No. 5 to Order 144	10,000	3,026
Amendment No. 1 to Order 145	7,500	3,800
Amendment No. 2 to Order 145	7,500	3,820
Amendment No. 1 to Order 146	7,500	4,819
Order 147	3,000	1,400
Order 148	1,000	1,000
Order 149	1,000	1,000
Order 150	20,000	20,000

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
BUREAU OF ANIMAL INDUSTRY—continued.		
Amendment No. 1 to Order 150	10,000	7,600
Order 151, Rule 1, revision 3	7,500	6,500
Meat Inspection Directory, by Number and Station, and Address List of Inspectors and Others	4,000	4,000
Meat Inspection Directory, by Number, etc., Aug. 5, 1907	5,500	5,500
BIOLOGICAL SURVEY.		
Report of Chief, 1907	2,500	1,500
Bulletin No. 28	1,000	1,000
Bulletin No. 29	4,500	3,665
Bulletin No. 30	5,000	2,500
Bulletin No. 31	5,000	4,635
Bulletin No. 32	5,000	4,560
Circular No. 17	1,000	460
Circular No. 60, revised	1,800	1,500
Circular No. 61	6,000	5,563
Circular No. 62	5,000	3,000
Circular No. 63	10,000	8,780
Circular No. 64	3,000	3,000
BUREAU OF CHEMISTRY.		
Report of the Chemist, 1907	500	500
Bulletin No. 13, part 9	500	240
Bulletin No. 46	250	112
Bulletin No. 65	250	250
Bulletin No. 68	300	132
Bulletin No. 73	250	88
Bulletin No. 75	300	154
Bulletin No. 77	1,000	305
Bulletin No. 80	1,000	332
Bulletin No. 81	200	50
Bulletin No. 84, part 2 (reprint)	500	321
Bulletin No. 84, part 3	1,000	1,000
Bulletin No. 86	200	200
Bulletin No. 90	200	117
Bulletin No. 91	500	269
Bulletin No. 92	2,000	300
Bulletin No. 98	1,000	125
Bulletin No. 105	1,500	1,300
Bulletin No. 106	2,100	1,675
Bulletin No. 107	1,000	1,000
Bulletin No. 108	3,000	2,750
Bulletin No. 109	2,500	2,053
Bulletin No. 110	2,500	2,036
Bulletin No. 111	3,000	2,270
Bulletin No. 112, part 1	1,000	1,000
Bulletin No. 112, part 2	1,000	1,000
Bulletin No. 113	2,500	1,511
Circular No. 12 (reprint)	500	364
Circular No. 13 (reprint)	200	10
Circular No. 14 (reprint)	5,000	3,420
Circular No. 15 (reprint)	500	364
Circular No. 16	3,000	2,336
Circular No. 20	300	40
Circular No. 23	250	107
Circular No. 25	300	600
Circular No. 32	200	10
Circular No. 34	2,500	150
Circular No. 35	2,500	2,370
Circular No. 36	10,500	4,100
Circular No. 37	5,000	5,000
Circular No. 38	1,600	1,600
Experimental Work With Pure Yeast Cultures in Determining the Chemical Character of the Fermented Products	500	500
Food Inspection Decisions:		
Nos. 40–43 (reprint)	20,000	22,815
Nos. 44–45 (reprint)	10,000	6,100
No. 46 as amended	10,000	10,000
Nos. 46–48	10,000	6,300
Nos. 49–53	10,000	7,430
Nos. 54–59	10,000	6,200
Nos. 60–64	5,000	4,000
No. 65	5,000	500
Nos. 66–68	5,000	8,100
No. 69	5,000	7,607
Nos. 70–72	40,000	31,140
No. 73	5,000	6,587

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
BUREAU OF CHEMISTRY—continued.		
Food Inspection Decisions—Continued.		
No. 74	20,000	18,000
No. 75	20,000	16,200
No. 76	35,000	27,531
No. 77	25,000	22,000
Nos. 78-79	20,000	15,700
Nos. 80-81	20,000	15,400
No. 82	25,000	21,000
No. 83	35,000	29,000
Nos. 84-85	35,000	21,000
No. 86	20,000	16,000
No. 87	20,000	15,400
No. 88	20,000	16,000
No. 89	20,000	16.100
No. 90	20,000	15,000
No. 91	20,000	15,400
No. 92	20,000	20,000
Nos. 93-95	25,000	19,000
No. 96	25,000	18,000
Notice of Judgment No. 1, Food and Drugs Act—Misbranding of Apple Cider	15,000	14,000
Notice of Judgment No. 2, Food and Drugs Act—Misbranding of Molasses	15,000	11,830
BUREAU OF ENTOMOLOGY.		
Report of the Entomologist, 1907	1,000	800
Bulletin No. 5 (reprint)	500	223
Bulletin No. 27 (revised)	1,000	330
Bulletin No. 29	1,000	400
Bulletin No. 43	1,000	180
Bulletin No. 60	1,000	137
Bulletin No. 61	1,000	602
Bulletin No. 62	2,000	1,292
Bulletin No. 63, part 3	1,000	200
Bulletin No. 64, part 4	2,000	1,626
Bulletin No. 64, part 5	2,000	1,606
Bulletin No. 65	1,000	51
Bulletin No. 66, part 3	2,000	1,600
Bulletin No. 67	1,800	1,460
Bulletin No. 68, part 2	2,000	2,000
Bulletin No. 68, part 3	2,000	1,819
Bulletin No. 68, part 4	2,000	2,000
Bulletin No. 68, part 5	2,000	1,730
Bulletin No. 68, part 6	2,000	1,760
Bulletin No. 68, part 7	2,000	1,856
Bulletin No. 71	1,000	1,000
Bulletin No. 72	4,000	3,220
Bulletin No. 73	3,000	1,935
Bulletin No. 74	3,000	2,060
Bulletin No. 75, part 1	3,000	2,274
Bulletin No. 75, part 2	3,000	2,200
Bulletin No. 75, part 3	3,000	1,700
Circular No. 14	250	250
Circular No. 17	250	250
Circular No. 32, third revise	5,000	2,205
Circular No. 34, revised (reprint)	5,000	400
Circular No. 36, revised	3,000	2,000
Circular No. 37, second revise	5,000	2,550
Circular No. 47, revised (reprint)	5,000	2,240
Circular No. 50, revised (reprint)	3,000	2,178
Circular No. 57, revised (reprint)	3,000	100
Circular No. 60	3,000	400
Circular No. 63	3,000	700
Circular No. 70 (reprint)	3,000	300
Circular No. 76, revised	3,000	2,110
Circular No. 77	3,000	1,507
Circular No. 79	5,000	730
Circular No. 84	3.000	200
Circular No. 86 (reprint)	2,000	460
Circular No. 87 (reprint)	2,000	1,211
Circular No. 88 (reprint)	3,000	3,447
Circular No. 90	3,000	500
Circular No. 91	3,000	2,200
Circular No. 92	6,000	4,021
Circular No. 93	5,000	4,830
Circular No. 94	5,000	3,472
Circular No. 95	30,000	10,000
Circular No. 96	3,000	2,530

Publications other than Farmers' Bulletins issued and distributed from July 1, 1907, to June 30, 1908—Continued.

	Issued.	Distributed.
BUREAU OF ENTOMOLOGY—continued.		
Circular No. [illegible]	[illegible]	[illegible]
Circular No. [illegible]	[illegible]	[illegible]
Circular No. [illegible]	[illegible]	[illegible]
Circular No. [illegible]	[illegible]	[illegible]
Circular No. [illegible]	[illegible]	[illegible]
Circular No. [illegible]	[illegible]	[illegible]
Bulletin No. [illegible], part [illegible], technical series	[illegible]	[illegible]
Bulletin No. [illegible], part [illegible], technical series	[illegible]	[illegible]
Bulletin No. [illegible], technical series	[illegible]	[illegible]
Bulletin No. [illegible], part [illegible], technical series	[illegible]	[illegible]
FOREST SERVICE.		
Bulletin No. 8 (reprint)	[illegible]	[illegible]
Bulletin No. 10 (reprint)	[illegible]	[illegible]
Bulletin No. 13, revised edition	[illegible]	[illegible]
Bulletin No. 17 (reprint)	[illegible]	[illegible]
Bulletin No. 24, part 2	[illegible]	[illegible]
Bulletin No. 26	[illegible]	[illegible]
Bulletin No. 32	[illegible]	[illegible]
Bulletin No. 36, part 1	[illegible]	[illegible]
Bulletin No. 38	[illegible]	[illegible]
Bulletin No. 44	[illegible]	[illegible]
Bulletin No. 47	[illegible]	[illegible]
Bulletin No. 49	[illegible]	[illegible]
Bulletin No. 50	[illegible]	[illegible]
Bulletin No. 52	[illegible]	[illegible]
Bulletin No. 53	[illegible]	[illegible]
Bulletin No. 57	[illegible]	[illegible]
Bulletin No. 58	[illegible]	[illegible]
Bulletin No. 60	[illegible]	[illegible]
Bulletin No. 61	[illegible]	[illegible]
Bulletin No. 65	[illegible]	[illegible]
Bulletin No. 68	[illegible]	[illegible]
Bulletin No. 70	[illegible]	[illegible]
Bulletin No. 71	[illegible]	[illegible]
Bulletin No. 77	[illegible]	[illegible]
Circular No. 15 (reprint)	[illegible]	[illegible]
Circular No. 21, fifth revision	[illegible]	[illegible]
Circular No. 22	[illegible]	[illegible]
Circular No. 23	[illegible]	[illegible]
Circular No. 25	[illegible]	[illegible]
Circular No. 35	[illegible]	[illegible]
Circular No. 36	[illegible]	[illegible]
Circular No. 37	[illegible]	[illegible]
Circular No. 39	[illegible]	[illegible]
Circular No. 42	[illegible]	[illegible]
Circular No. 46	[illegible]	[illegible]
Circular No. 47	[illegible]	[illegible]
Circular No. 54	[illegible]	[illegible]
Circular No. 55	[illegible]	[illegible]
Circular No. 56	[illegible]	[illegible]
Circular No. 57	[illegible]	[illegible]
Circular No. 58	[illegible]	[illegible]
Circular No. 59	[illegible]	[illegible]
Circular No. 61	[illegible]	[illegible]
Circular No. 62	[illegible]	[illegible]
Circular No. 63	[illegible]	925
Circular No. 64	[illegible]	[illegible]
Circular No. 65	[illegible]	912
Circular No. 66	[illegible]	1,082
Circular No. 67	3,000	[illegible]
Circular No. 68	[illegible]	[illegible]
Circular No. 69	[illegible]	2,500
Circular No. 70	[illegible]	1,015
Circular No. 71	4,500	[illegible]
Circular No. 72	3,000	674
Circular No. 74	4,000	1,000
Circular No. 75	1,500	[illegible]
Circular No. 76	2,000	[illegible]
Circular No. 77	4,000	[illegible]
Circular No. 80	1,500	[illegible]
Circular No. 82	4,500	[illegible]
Circular No. 84	4,000	2,546
Circular No. 85	3,000	[illegible]
Circular No. 86	3,000	[illegible]
Circular No. 87	4,000	[illegible]
Circular No. 88	4,000	[illegible]
Circular No. 89	2,000	[illegible]

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
FOREST SERVICE—continued.		
Circular No. 90	2,000	892
Circular No. 91	3,000	2,205
Circular No. 92	4,000	3,205
Circular No. 93	4,000	2,487
Circular No. 94	4,000	2,919
Circular No. 95	5,000	2,665
Circular No 99	85,000	81,600
Circular No. 101	24,000	23,249
Circular No. 102	51,000	49,170
Circular No. 103	24,500	24,500
Circular No. 104	25,000	24,606
Circular No. 105	21,000	19,473
Circular No. 106	12,000	10,454
Circular No. 107	1,000	58,000
Circular No. 108	22,000	17,544
Circular No. 109	50,000	46,785
Circular No. 110	8,000	8,000
Circular No. 111	29,000	28,104
Circular No. 112	32,000	32,000
Circular No. 113	103,000	102,740
Circular No. 114	59,000	58,648
Circular No. 115	37,000	35,000
Circular No. 116	410,000	400,000
Circular No. 117	366,000	364,358
Circular No. 118	20,000	17,900
Circular No. 119	14,200	12,900
Circular No. 120	13,400	13,400
Circular No. 121	13,000	10,000
Circular No. 122	80,500	80,500
Circular No. 123	10,500	10,500
Circular No. 124	27,000	25,967
Circular No. 125	9,500	8,241
Circular No. 126	15,000	15,000
Circular No. 127	30,000	23,225
Circular No. 128	24,000	24,000
Circular No. 129	740,000	712,000
Circular No. 130	142,000	137,300
Circular No. 131	33,000	32,477
Circular No. 132	29,000	28,750
Circular No. 133	9,000	9,000
Circular No. 134	28,000	28,000
Circular No. 136	22,500	22,500
Circular No. 137	30,000	28,947
Circular No. 138	220,000	119,070
Circular No. 139	50,000	50,000
Circular No. 140	740,000	733,000
Circular No. 141	22,000	22,000
Circular No. 142	11,500	11,500
Circular No. 143	24,000	21,348
Circular No. 144	29,000	29,000
Circular No. 145	30,000	27,907
Circular No. 146	13,000	7,400
Circular No. 147	24,000	22,773
Circular No. 148	9,000	7,702
Circular No. 149	15,000	15,000
Press Bulletin No. 152	8,000	8,000
Press Bulletin No. 153	8,000	8,000
Press Bulletin No. 154	8,000	8,000
Press Bulletin No. 155	8,000	8,000
Press Bulletin No. 156	11,500	11,500
Press Bulletin No. 157	9,000	9,000
Silvical Leaflet No. 1	7,000	7,000
Silvical Leaflet No. 2	7,000	7,000
Silvical Leaflet No. 3	7,000	7,000
Silvical Leaflet No. 4	7,000	7,000
Silvical Leaflet No. 5	7,000	7,000
Silvical Leaflet No. 6	7,000	7,000
Silvical Leaflet No. 7	7,000	7,000
Silvical Leaflet No. 8	7,000	7,000
Silvical Leaflet No. 9	7,000	7,000
Silvical Leaflet No. 10	7,000	7,000
Silvical Leaflet No. 11	7,000	7,000
Silvical Leaflet No. 12	7,000	7,000
Silvical Leaflet No. 13	7,000	7,000
Silvical Leaflet No. 14	7,000	7,000
Press Review, "The Use of the National Forests"	7,500	7,500
Press Review of Circular No. 79	3,000	3,000
Press Review of Circular No. 81	3,100	3,100
Press Review of Circular No. 97	24,100	24,100

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
FOREST SERVICE—continued.		
Press Review of Circular No. 99	5,300	5,300
Press Review of Circular No. 100	9,450	9,450
Press Review No. 8 B	5,000	5,000
Press Review No. 9	3,750	3,750
Press Review No. 10	2,300	2,300
Press Review No. 11	13,000	13,000
Press Review No. 12	2,100	2,100
Press Review No. 13	2,000	2,000
Press Review No. 14	2,150	2,150
Press Review No. 15	2,275	2,275
Press Review No. 17	18,428	18,428
Press Review No. 18	1,500	1,500
Press Review No. 19	5,676	5,676
Press Review No. 20	2,300	2,300
Press Review No. 21	2,500	2,500
Press Review No. 22	24,000	24,000
Press Review No. 23	6,375	6,375
Press Review No. 24	2,700	2,700
Press Review No. 25	5,000	5,000
Press Review No. 26	18,500	18,500
Press Review No. 27	24,000	24,000
Press Review No. 28	11,000	11,000
Press Review No. 29	24,000	24,000
Press Review No. 30	8,200	8,200
Press Review No. 31	24,000	24,000
Press Review No. 32	24,000	24,000
Press Review No. 33	3,050	3,050
Press Review No. 34	6,000	6,000
Press Review No. 35	15,200	15,200
Press Review No. 36	3,300	3,300
Senate Doc. 91 (Sixtieth Congress, first session)—Report of the Secretary of Agriculture on the Southern Appalachian and White Mountain Watersheds	26,000	25,000
The Use of the National Forests	310,000	310,000
The Green Book	3,500	3,500
Field Program for July, 1907	2,500	2,500
Field Program for August, 1907	3,000	3,000
Field Program for September, 1907	2,500	2,500
Field Program for October, 1907	3,000	3,000
Field Program for November, 1907	3,000	3,000
Field Program for December, 1907	3,000	3,000
Field Program for January, 1908	3,000	3,000
Field Program for February, 1908	3,000	3,000
Field Program for March, 1908	3,300	3,300
Field Program for April, 1908	3,300	3,300
Field Program for May, 1908	3,300	3,300
Field Program for June, 1908	2,600	2,600
Suggestions for the Disposal of Brush in the National Forests	3,000	3,000
Directions and Specifications for Building Telephone Lines in the National Forests	2,500	2,500
Production of Lumber, Laths, and Shingles, by States and Species, 1906, 1905, 1904	25,000	25,000
Report of the Forester for 1905	1,000	272
Report of the Forester for 1906	1,000	1,000
Report of the Forester for 1907	2,500	2,500
LIBRARY.		
Report of the Librarian, 1907	350	150
Bulletin No. 64	1,000	860
Bulletin No. 65	1,000	845
Bulletin No. 66	1,000	800
Bulletin No. 37, Supplement No. 1 (1901-1905)	1,000	720
OFFICE OF EXPERIMENT STATIONS.		
Report of the Director, 1907	2,500	905
Bulletin No. 28, revised	2,000	511
Bulletin No. 134	500	100
Bulletin No. 145	500	400
Bulletin No. 147	1,000	216
Bulletin No. 148	1,000	150
Bulletin No. 155	1,000	100
Bulletin No. 160	3,000	200
Bulletin No. 163	1,000	100
Bulletin No. 166	1,000	65
Bulletin No. 172	1,000	50
Bulletin No. 181	5,000	3,900
Bulletin No. 185	1,000	400

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
OFFICE OF EXPERIMENT STATIONS—continued.		
Bulletin No. 186	10,000	10,900
Bulletin No. 188	6,000	3,000
Bulletin No. 189	5,000	2,602
Bulletin No. 190, part 1	3,500	2,000
Bulletin No. 191	6,000	5,110
Bulletin No. 192	3,000	2,000
Bulletin No. 193	3,000	3,000
Bulletin No. 194	3,000	2,700
Bulletin No. 195	15,000	7,266
Bulletin No. 196	1,000	1,000
Bulletin No. 197	3,000	1,500
Bulletin No. 198	5,000	2,980
Bulletin No. 199	5,000	4,896
Circular No. 47 (reprint)	100	100
Circular No. 51, revised	2,500	1,500
Circular No. 68	1,000	1,000
Circular No. 69	2,000	1,171
Circular No. 70	1,500	1,246
Circular No. 73	7,500	3,700
Circular No. 74	6,000	3,413
Circular No. 75	12,000	10,351
Circular No. 76	6,000	5,267
Circular No. 77	8,000	6,090
Circular No. 78	3,000	1,700
Experiment Station Work:		
Vol. 2, Index	3,000	2,300
Vol. 3, No. 1	3,000	2,618
Vol. 3, No. 2	3,000	2,843
Vol. 3, No. 3	3,000	2,837
Vol. 3, No. 4	3,000	3,000
Vol. 3, No. 5	3,000	2,778
Alaska Agricultural Experiment Station Bulletin No. 3	1,500	1,320
Porto Rico Experiment Station Bulletin No. 7 (Spanish edition)	3,000	3,000
Hawaiian Experiment Station Bulletin No. 15	4,000	3,729
Hawaiian Experiment Station Bulletin No. 17	5,000	430
Annual Report, 1906	5,000	4,500
Doc. 369. No. 1. (Reprint from Bulletin 86)	1,000	100
Reprints from Bulletin 119:		
Doc. 546. No. 1	1,000	100
Doc. 547. No. 2	1,000	28
Doc. 548. No. 3	1,000	30
Reprints from Bulletin 133:		
Doc. 624. No. 1, 1902	1,000	62
Doc. 625. No. 2	1,000	69
Farmers' Institute Lecture No. 7	3,000	1,879
Farmers' Institute Lecture No. 8	3,000	2,158
Farmers' Institute Lecture No. 9	3,000	2,419
Doc. 805. County Schools of Agriculture in Wisconsin (reprint from Annual Report, 1904)	500	60
Reprints from Bulletin No. 158:		
Doc. 837. Separate No. 1	1,000	201
Doc. 841. Separate No. 5	1,000	807
Doc. 840. Separate No. 4	500	111
Doc. 843. Separate No. 7	500	100
Doc. 844. Separate No. 8	500	108
Doc. 893. Courses in Agriculture, Horticulture and Allied Subjects (reprint from Bulletin 164)	300	12
Doc. 1008. Annual Report of the Hawaiian Agricultural Experiment Station, 1907	5,000	4,232
Doc. 1011. Form of Organization for Farmers' Institutes	3,000	1,739
Doc. 1020. List of station publications received during June, 1907	3,750	2,955
Reprints from Annual Report, 1906:		
Doc. 1023. Work and expenditures of the Agricultural Experiment Station	1,000	320
Doc. 1024. Statistics of Land-Grant Colleges and Agricultural Experiment Stations, 1906	500	400
Doc. 1025. Progress in Agricultural Education, 1906	7,000	6,027
Doc. 1026. The Farmers' Institutes in the United States, 1906	4,500	4,000
Doc. 1027. The Nutrition Investigations of the O. E. S. and Their Results	1,500	500
Doc. 1028. Reclamation of Tide Lands	3,000	1,900
Doc. 1029. Experiment Station Work with Peaches	1,700	855
Doc. 1032. List of station publications received during July, 1907	3,750	3,168
Doc. 1037. List of station publications received during August, 1907	3,750	3,750
Doc. 1044. List of station publications received during September, 1907	3,750	3,750
Doc. 1046. List of publications on Irrigation and Drainage	1,000	1,000
Doc. 1048. List of station publications received during October, 1907	3,750	3,521
Doc. 1051. List of publications of O. E. S. on Agricultural Education, corrected to October 15, 1907	1,000	1,000
Doc. 1052. List of publications of O. E. S. on the Food and Nutrition of Man, corrected to October 15, 1907	1,500	700

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
OFFICE OF EXPERIMENT STATIONS—continued.		
Doc. 1054. List of station publications received during November, 1907	3,750	950
Doc. 1056. The Economic Seaweeds of Hawaii and Their Food Value (reprint from Annual Report, 1906)	1,000	542
Reprints from Bulletin No. 196:		
Doc. 1060. Address by Robert Wallace	100	100
Doc. 1061. Development of Agricultural Education	500	500
Doc. 1062. The Development of Engineering Education in the Land-Grant Colleges	500	500
Doc. 1063. List of publications of O. E. S. on Food and Nutrition of Man, corrected to December 10, 1907	1,500	800
Doc. 1065. List of station publications received during December, 1907	3,750	3,750
Doc. 1066. Work and publications of Drainage Investigations	4,000	4,000
Doc. 1073. List of publications received during January, 1908	3,750	3,750
Doc. 1075. Annual Report of the Porto Rico Agricultural Experiment Station, 1907	5,000	4,000
Doc. 1076. List of Publications of O. E. S. on Agricultural Education, corrected to February 15, 1908	3,500	3,500
Doc. 1079. Organization, work and publications of Irrigation Investigations	2,000	2,000
Doc. 1080. List of station publications received during February, 1908	3,750	3,750
Doc. 1085. Annual Report of the Hawaii Agricultural Experiment Station, 1907	5,000	4,136
Doc. 1087. List of station publications received during March, 1908	3,750	3,750
Doc. 1089. Changes in the Personnel of the O. E. S., and Factors Influencing Them (reprint from O. E. S. Record, Vol. 19, No. 7)	500	140
Doc. 1091. List of station publications received during April, 1908	3,750	3,750
Doc. 1093. The Fermentation of Cacao and Coffee (reprint from Annual Report Porto Rico Agricultural Experiment Station, 1907)	200	200
Doc. 1094. List of Publications of O. E. S., on Agricultural Education	1,000	634
Doc. 1095. Work and publications of Drainage Investigations	4,000	1,000
Doc. 1097. List of station publications received during May, 1908	3,750	3,750
Doc. 1099. Dairy Practice at Kenai Station (reprint from Annual Report Alaska Experiment Station, 1907)	2,000	600
DIVISION OF PUBLICATIONS.		
Report of the Editor, 1907	1,000	400
Bulletin No. 8	2,000	1,050
Circular No. 1, revised to January 1, 1908	3,000	1,613
Circular No. 2, revised to July 1, 1907	10,000	10,000
Circular No. 2, revised to December 15, 1907	10,000	10,000
Circular No. 3 (reprint)	3,500	5,069
Circular No. 3, revised to October, 1907	10,000	10,000
Circular No. 4, revised	9,500	9,116
Circular No. 5	1,500	1,500
Press Notice No. 576	1,200	1,200
Press Notice No. 580	1,500	1,500
Press Notice No. 582	1,500	1,500
Press Notice No. 584	1,700	1,700
Press Notice No. 593	1,600	1,600
Press Notice No. 594	1,600	1,600
Press Notice No. 597	1,900	1,900
Press Notice No. 598	1,500	1,500
Press Notice No. 606	1,100	1,100
Monthly List of Publications, July, 1907	230,000	230,000
Foreign Monthly List of Publications, July, 1907	4,000	4,000
Monthly List of Publications, August, 1907	235,000	235,000
Foreign Monthly List of Publications, August, 1907	4,000	4,000
Monthly List of Publications, September, 1907	235,000	235,000
Foreign Monthly List of Publications, September, 1907	4,000	4,000
Monthly List of Publications, October, 1907	235,000	235,000
Foreign Monthly List of Publications, October, 1907	4,000	4,000
Monthly List of Publications, November, 1907	235,000	235,000
Foreign Monthly List of Publications, November, 1907	4,000	4,000
Foreign Monthly List of Publications, December, 1907	4,000	4,000
Monthly List of Publications, December, 1907, and January, 1908	235,000	235,000
Foreign Monthly List of Publications, February, 1908	5,000	5,000
Monthly List of Publications, February and March, 1908	215,000	215,000
Foreign Monthly List of Publications, March, 1908	4,000	4,000
Foreign Monthly List of Publications, April, 1908	5,000	5,000
Monthly List of Publications, April and May, 1908	221,000	221,000
BUREAU OF PLANT INDUSTRY.		
Report of Chief, 1906 (reprint)	500	66
Report of Chief, 1907	2,000	1,337
Bulletin No. 78 (reprint)	300	176
Bulletin No. 90, part 3	300	50
Bulletin No. 98	500	108
Bulletin No. 100, part 7	1,000	200

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
BUREAU OF PLANT INDUSTRY—continued.		
Bulletin No. 100, part 8	1,000	300
Bulletin No. 101	2,000	1,674
Bulletin No. 102	2,500	2,500
Bulletin No. 102, part 1	300	5
Bulletin No. 102, part 3	300	40
Bulletin No. 102, part 7	4,000	4,000
Bulletin No. 103	300	148
Bulletin No. 106	1,000	1,000
Bulletin No. 107	3,000	2,526
Bulletin No. 108	4,000	3,590
Bulletin No. 109	1,000	1,000
Bulletin No. 110	2,000	1,710
Bulletin No. 111	2,500	1,500
Bulletin No. 111, part 1	2,000	1,460
Bulletin No. 111, part 2	3,000	2,160
Bulletin No. 111, part 3	3,500	3,253
Bulletin No. 111, part 4	5,000	5,000
Bulletin No. 111, part 5	3,600	3,374
Bulletin No. 112	2,000	1,575
Bulletin No. 113	1,800	1,533
Bulletin No. 114	2,000	2,000
Bulletin No. 115	3,000	2,100
Bulletin No. 116	3,000	3,000
Bulletin No. 117	2,750	2,510
Bulletin No. 118	2,000	2,000
Bulletin No. 119	4,000	2,700
Bulletin No. 120	2,000	1,420
Bulletin No. 121	2,500	1,600
Bulletin No. 121, part 1	2,500	1,840
Bulletin No. 121, part 2	2,000	1,781
Bulletin No. 121, part 3	3,000	3,000
Bulletin No. 121, part 4	2,000	1,485
Bulletin No. 121, part 5	4,500	3,300
Bulletin No. 121, part 6	2,500	1,900
Bulletin No. 122	2,000	1,438
Bulletin No. 123	8,000	5,730
Bulletin No. 124	5,500	4,200
Bulletin No. 125	2,000	1,500
Bulletin No. 126	1,000	1,000
Bulletin No. 127	8,165	2,684
Bulletin No. 128	2,500	1,538
Bulletin No. 131, part 1	4,500	2,500
Bulletin No. 131, part 2	2,000	1,461
Bulletin No. 131, part 3	12,500	2,500
Bulletin No. 131, part 4	1,800	1,406
Circular No. 1	4,700	4,700
Circular No. 2	3,500	1,800
Circular No. 3	12,000	3,137
Circular No. 4	3,000	2,467
Circular No. 5	2,500	1,731
Circular No. 6	3,500	809
Circular No. 7	3,500	2,745
Circular No. 8	3,000	1,486
Circular No. 9	6,000	1,500
Circular No. 10	3,000	2,038
Farmers' Cooperative Demonstration Work.		
No. "A"—51	65,000	65,000
No. "A"—52	60,000	60,000
No. "A"—53	75,000	75,000
No. "A"—58	60,000	60,000
No. "A"—59	60,000	60,000
No. "A"—60	60,000	60,000
OFFICE OF PUBLIC ROADS.		
Report of Director, 1907	600	360
Bulletin No. 30	5,000	4,356
Bulletin No. 31	4,300	3,154
Bulletin No. 32	8,800	4,872
Bulletin No. 47	1,000	300
Circular No. 48	2,000	1,583
Circular No. 88	1,100	1,100
Circular No. 89	10,000	5,100

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
OFFICE OF THE SECRETARY.		
Preliminary Report of the Secretary, 1907	5,000	5,000
Report No. 58	500	25
Report No. 60	350	150
Report No. 62	400	190
Report No. 63	300	135
Report No. 84	3,000	4,546
Report No. 85	8,000	7,200
Circular No. 21	45,000	28,300
Circular No. 24	15,000	10,300
Circular No. 25	7,000	4,970
Cricular No. 26	65,000	65,000
Annual Report of the Department of Agriculture, 1907	1,500	950
House Doc. No. 743. Operations of the Bureau of Animal Industry, 1906	25	25
Senate Doc. No. 132. Report of the Secretary on the Work of the Biological Survey	100	100
Fiscal Regulations of the U. S. Department of Agriculture, revised to Oct. 1, 1907	7,500	7,500
Report of the New Building Operations for 1907	500	500
BUREAU OF STATISTICS.		
Report of the Statistician, 1907	1,000	465
Bulletin No. 39	500	131
Bulletin No. 41	500	175
Bulletin No. 49	7,000	1,000
Bulletin No. 50	500	165
Bulletin No. 52	5,000	4,600
Bulletin No. 53	5,000	5,000
Bulletin No. 54	5,000	5,000
Bulletin No. 55	7,500	5,300
Bulletin No. 56	4,500	3,596
Bulletin No. 57	4,500	3,500
Bulletin No. 58	4,500	3,716
Bulletin No. 59	4,500	4,070
Bulletin No. 60	4,500	3,500
Bulletin No. 61	4,500	3,564
Bulletin No. 62	4,500	3,500
Bulletin No. 63	4,500	1,224
Bulletin No. 65	4,500	4,500
Bulletin No. 66	4,000	3,409
Bulletin No. 67	6,000	5,466
Bulletin No. 68	4,500	3,400
Bulletin No. 69	4,500	3,500
Crop Reporter:		
Vol. 9, No. 7	120,000	120,000
Vol. 9, No. 8	135,000	135,000
Vol. 9, No. 9	130,000	130,000
Vol. 9, No. 10	130,000	130,000
Vol. 9, No. 11	130,000	130,000
Vol. 9, No. 12	132,500	132,500
Vol. 9, No. 12, Supplement	132,500	132,500
Vol. 10 No. 1	130,000	130,000
Vol. 10, No. 2	125,000	125,000
Vol. 10, No. 3	133,000	133,000
Vol. 10, No. 4	133,000	133,000
Vol. 10, No. 5	135,000	135,000
Vol. 10, No. 6	135,000	135,000
BUREAU OF SOILS.		
Report of the Chief, 1907	100	100
Bulletin No. 21	300	300
Bulletin No. 34	500	500
Bulletin No. 35	800	800
Bulletin No. 36	500	2,618
Bulletin No. 41	500	250
Bulletin No. 42	2,500	2,352
Bulletin No. 43	2,800	2,512
Bulletin No. 44	2,500	2,500
Bulletin No. 45	2,500	2,272
Bulletin No. 46	2,500	1,500
Bulletin No. 47	2,500	2,000
Bulletin No. 48	2,500	2,500
Bulletin No. 49	2,500	260
Bulletin No. 50	2,500	2.500
Bulletin No. 51	2,500	935
Advance sheets of Field Operations:		
Soil Survey of Fayetteville Area, Arkansas, 1906	1,000	400
Soil Survey of Prairie County, Arkansas, 1906	1,000	609
Soil Survey of Conway County, Arkansas, 1907	1,000	233

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distributed.
BUREAU OF SOILS—continued.		
Advance sheets of Field Operations—Continued.		
Soil Survey of Green County, Indiana, 1906	1,000	405
Soil Survey of Tishomingo Area, Indian Territory, 1906	1,000	800
Soil Survey of Riley County, Kansas, 1906	1,000	375
Soil Survey of Cass County, Michigan, 1906	1,000	488
Soil Survey of Blue Earth County, Minnesota, 1906	1,000	380
Soil Survey of Crookston Area, Minnesota, 1906	1,000	373
Soil Survey of Putnam County, Missouri, 1906	1,000	338
Soil Survey of Lancaster County, Nebraska, 1906	1,000	374
Soil Survey of Merrimack County, New Hampshire, 1906	1,000	400
Soil Survey of Madison County, New York, 1906	1,000	1,000
Soil Survey of Niagara County, New York, 1906	1,000	475
Soil Survey of Chowan County, North Carolina, 1906	1,000	716
Soil Survey of Transylvania County, North Carolina, 1906	1,000	600
Soil Survey of Edgecombe County, North Carolina, 1906	1,000	257
Soil Survey of Ransom County, North Dakota, 1906	1,000	425
Soil Survey of Williston Area, North Dakota, 1906	1,000	585
Soil Survey of Meigs County, Ohio, 1906	1,000	330
Soil Survey of Oklahoma County, Oklahoma, 1906	1,000	515
Soil Survey of Chester County, Pennsylvania, 1905	1,000	1,000
Soil Survey of Grainger County, Tennessee, 1906	1,000	366
Soil Survey of Madison County, Tennessee, 1906	1,000	400
Soil Survey of Henderson Area, Texas, 1905	1,000	428
Soil Survey of Laredo Area, Texas, 1906	1,000	785
Soil Survey of Wilson County, Texas, 1907	1,000	233
Soil Survey of Chesterfield County, Virginia, 1906	1,000	350
Soil Survey of Wheeling Area, West Virginia, 1906	1,000	415
Soil Survey of Racine County, Wisconsin, 1906	1,000	737
EXTRACTS FROM YEARBOOKS.		
No. 87. Pruning and Training Grapevines	1,000	158
No. 133. Birds as Weed Destroyers	5,000	2,380
No. 157. Pollination of Pomaceous Fruits	1,000	200
No. 197. How Birds Affect the Orchard	1,500	100
No. 233. Some Problems of the Rural Common Schools	300	594
No. 247. Two Vanishing Game Birds—The Woodcock and the Wood Duck	1,500	1,345
No. 249. A Working Plan for Southern Hard Wood and Its Results	2,000	910
No. 266. Top Working Orchard Trees	1,000	684
No. 270. Practicability of Forest Planting in the United States	1,000	1,000
No. 274. Influence of Forestry Upon the Lumber Industry	1,000	1,258
No. 285. Progress in Secondary Education in Agriculture	200	40
No. 309. The Economic Value of the Bobwhite	1,500	409
No. 324. Wheat Flour and Bread	1,000	100
No. 329. The Relation of Forests to Stream Flow	3,000	3,262
No. 332. Building Sand-Clay Roads in Southern States	3,000	611
No. 343. New Citrus Creations of the Department of Agriculture	1,000	748
No. 350. Practical Road Building in Madison County, Tennessee	3,000	2,706
No. 354. Some Uses of the Grapevine and Its Fruits	1,000	1,600
No. 355. Insects Injurious to Forest Products	1,000	160
No. 360. Annual Loss Occasioned by Destructive Insects in United States	2,000	602
No. 362. Boys' Agricultural Clubs	1,500	1,500
No. 377. Diversified Farming in the Cotton Belt	1,000	1,000
No. 381. Insect Enemies of Forest Reproduction	1,000	100
No. 382. The Use of Illustrated Material in Teaching Agriculture in Rural Schools	3,000	716
No. 386. The Principal Insect Enemies of the Peach	2,000	138
No. 393. The Relation of Irrigation to Dry Farming	1,000	43
No. 401. Progress in Drug-Plant Cultivation	2,000	877
No. 410. New Problems of the Weather	700	700
No. 411. The Present Status of the Nitrogen Problem	1,000	1,000
No. 412. Object-Lesson Roads	4,000	2,392
No. 413. Introduction of Elementary Agriculture into Schools	5,000	4,053
No. 414. Cage-Bird Traffic of the United States	3,000	3,000
No. 415. The Use of Soil Surveys	1,000	1,000
No. 416. Birds that Eat Scale Insects	5,000	4,692
No. 417. The Effect of Climatic Conditions on the Composition of Durum Wheat	500	300
No. 418. The Game Warden of To-day	3,000	3,000
No. 419. Range Management	2,000	1,209
No. 420. The Preparation of Unfermented Apple Juice	2,000	1,817
No. 421. Foreign Restrictions on American Meat	3,000	3,000
No. 422. Methods of Reducing the Cost of Producing Beet Sugar	1,000	507
No. 423. Corn-Breeding Work at the Experiment Stations	500	500
No. 424. Nuts and Their Uses as Food	3,500	2,100
No. 425. Some Recent Studies of the Mexican Cotton Boll Weevil	3,000	2,414
No. 427. New Citrus and Pineapple Production of the Department of Agriculture	3,500	3,127
No. 428. Distribution of Tuberculin and Mallein by the Bureau of Animal Industry	1,000	365

Publications, other than Farmers' Bulletins, received and distributed from July 1, 1907, to June 30, 1908—Continued.

	Received.	Distrib-uted.
EXTRACTS FROM YEARBOOKS—continued.		
No. 429. Promising New Fruits	5,000	2,900
No. 430. Freight Costs and Market Values	3,500	3,100
No. 431. New Tobacco Varieties	500	500
No. 432. Opportunities for Dairying	2,000	1,136
No. 433. Lime-Sulphur Washes for the San Jose Scale	3,000	2,661
No. 434. National Forests and the Lumber Supply	29,000	27,000
No. 435. A Directory for Farmers	10,000	7,000
No. 436. Agricultural Statistics, 1906	10,000	8,425
No. 437. Plant Diseases in 1906	700	600
No. 438. The Principal Injurious Insects of 1906	500	500
No. 439. Progress of Forestry in 1906	32,000	32,000
No. 440. Game Protection in 1906	5,000	4,100
	11,892,770	11,755,756

Farmers' bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1907–8.

No. of bulle-tin.	Title of bulletin.	Total number received.	Distrib-uted to Congress-men.[a]	Miscella-neous dis-tribution.[a]
22	The Feeding of Farm Animals	70,629	51,851	20,290
24	Hog Cholera and Swine Plague	45,000	38,017	13,333
25	Peanuts: Culture and Uses	20,000	4,965	12,792
27	Flax for Seed and Fiber		5,402	4,959
28	Weeds; And How to Kill Them	50,000	26,355	22,075
29	Souring and Other Changes in Milk		2,192	2,589
30	Grape Diseases on the Pacific Coast		3,550	3,877
32	Silos and Silage	30,000	11,811	10,738
33	Peach Growing for Market	30,000	14,257	11,659
34	Meats: Composition and Cooking	40,000	15,648	15,956
35	Potato Culture	60,000	34,821	20,491
36	Cotton Seed and Its Products	30,147	15,183	11,190
39	Onion Culture	20,000	8,821	15,865
42	Facts About Milk	35,976	23,913	16,405
44	Commercial Fertilizers	35,000	21,859	17,056
46	Irrigation in Humid Climates		125	219
47	Insects Affecting the Cotton Plant	16,500	10,417	9,139
48	The Manuring of Cotton	20,200	15,365	6,125
49	Sheep Feeding	10,500	8,604	7,770
51	Standard Varieties of Chickens	95,400	64,368	30,612
52	The Sugar Beet	25,000	19,512	7,845
54	Some Common Birds	30,200	13,741	16,983
55	The Dairy Herd	35,300	21,552	14,266
56	Experiment Station Work—I	5,019	6,914	7,123
58	The Soy Bean as a Forage Crop	15,100	6,231	6 893
59	Bee Keeping	25,500	10,515	15,740
60	Methods of Curing Tobacco	25,000	17,815	6,958
61	Asparagus Culture	20,000	9,963	13,910
62	Marketing Farm Produce	30,000	18,835	11,979
63	Care of Milk on the Farm	38,750	24,448	17,211
64	Ducks and Geese	35,000	17,763	18,155
65	Experiment Station Work—II	16,500	8,547	6,715
66	Meadows and Pastures	25,200	9,928	8,631
69	Experiment Station Work—III	15,000	9,014	5,830
71	Essentials in Beef Production	15,000	15,198	6,272
72	Cattle Ranges of the Southwest	10,200	3,052	4,033
73	Experiment Station Work—IV	15,000	6,000	7,771
74	Milk as Food	30,000	14,073	14,510
77	The Liming of Soils	20,000	9,245	10,521
78	Experiment Station Work—V	10,547	6,046	5,900
79	Experiment Station Work—VI	10,000	7,427	6,476
80	The Peach Twig-borer	15,000	6,704	6,729
81	Corn Culture in the South	40,000	28,452	10,295
82	The Culture of Tobacco	20,700	17,336	7,284
83	Tobacco Soils	15,400	15,000	6,713
84	Experiment Station Work—VII	10,000	7,601	7,601
85	Fish as Food	20,000	12,676	11,401
86	Thirty Poisonous Plants	26,060	12,307	13,042

[a] Where the number distributed is greater than the number received, the difference is accounted for by the number on hand at the beginning of the year.

Farmers' bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1907-8—Continued.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
87	Experiment Station Work—VIII	10,000	5,657	6,425
88	Alkali Lands	....	5,761	5,211
91	Potato Diseases and Their Treatment	35,000	22,626	16,218
92	Experiment Station Work—IX	5,000	4,578	6,121
93	Sugar as Food	20,000	8,559	11,580
95	Good Roads for Farmers	84,800	71,971	16,859
96	Raising Sheep for Mutton	10,000	8,350	8,627
97	Experiment Station Work—X	8,050	7,402	6,472
98	Suggestions to Southern Farmers	25,000	17,053	8,327
99	Three Insect Enemies of Shade Trees	11,000	7.549	7,789
100	Hog Raising in the South	35,500	27,551	9,561
101	Millets	10,300	5,745	6,073
102	Southern Forage Plants	20,000	15,814	6,220
103	Experiment Station Work—XI	12 000	7,835	6,130
104	Notes on Frost	21,000	6,235	11,783
105	Experiment Station Work—XII	15,300	6,444	5,829
106	Breeds of Dairy Cattle	30,000	21,495	13,308
107	Experiment Station Work—XIII	10,000	5,768	6,262
108	Saltbushes	....	14,849	3,474
109	Farmers' Reading Courses	15,000	8,661	7,922
110	Rice Culture in the United States	10,000	3,101	4,882
111	Farmers' Interest in Good Seed	20,000	15,084	8,556
112	Bread and Bread Making	45,000	26,430	18,863
113	The Apple and How to Grow It	45,000	29,531	20,498
114	Experiment Station Work—XIV	15,000	5,573	5,956
115	Hop Culture in California	....	1,724	1,778
116	Irrigation in Fruit Growing	20,000	7,440	10,092
118	Grape Growing in the South	15,000	6,861	7,374
119	Experiment Station Work—XV	10,000	9,935	5,696
120	Insects Affecting Tobacco	20,000	11,946	6,026
121	Beans, Peas, and other Legumes as Food	25,328	14,662	15,251
122	Experiment Station Work—XVI	10,000	6,946	6,061
124	Experiment Station Work—XVII	15,000	8,012	6,848
125	Protection of Food Products from Injurious Temperatures	15,000	6,136	7,340
126	Practical Suggestions for Farm Buildings	45,300	29,912	14,924
127	Important Insecticides	20,118	5,135	7,577
128	Eggs and Their Uses as Food	30,224	18,461	19,538
129	Sweet Potatoes	20,650	12,724	13,149
131	Household Tests for Detection of Oleomargarine and Renovated Butter	10,300	8,764	6,028
132	Insect Enemies of Growing Wheat	20,000	10,264	8,611
133	Experiment Station Work—XVIII	5,448	6,103	6,619
134	Tree Planting in Rural School Grounds	30.000	12,949	12,819
135	Sorghum Sirup Manufacture	20,250	7,798	5,585
137	The Angora Goat	25.400	12,090	7,132
138	Irrigation in Field and Garden	13,213	9,427	10,422
139	Emmer: A Grain for the Semiarid Regions	....	2,884	4,173
140	Pineapple Growing	10,000	3,138	4,861
142	Principles of Nutrition and Nutritive Value of Food	30,000	11,946	16,454
143	Conformation of Beef and Dairy Cattle	10,239	10,283	7,233
144	Experiment Station Work—XIX	20,000	4,965	6,522
145	Carbon Bisulphid as an Insecticide	15,500	2.863	7,793
147	Winter Forage Crops for the South	20,250	14,592	5,678
149	Experiment Station Work—XX	20,000	8,500	6,683
150	Clearing New Land	10,500	6,577	7,159
151	Dairying in the South	18.100	13,938	5,279
152	Scabies of Cattle	16,000	6,947	5,046
153	Orchard Enemies in the Northwest	10,000	5,301	4,695
154	The Home Fruit Garden: Preparation and Care	40,600	23,964	12,624
155	How Insects Affect Health in Rural Districts	17,000	8,775	11,692
156	The Home Vineyard	25,000	10,862	13,632
157	The Propagation of Plants	20,000	9,328	11,378
158	How to Build Small Irrigation Ditches	20,000	9,736	9,756
159	Scab in Sheep	25,000	9,941	7,033
161	Practical Suggestions for Fruit Growers	40,900	24.918	13,414
162	Experiment Station Work—XXI	20,000	7,267	5,747
164	Rape as a Forage Crop	10,144	6,914	6,232
165	Silkworm Culture	10,000	2,565	7,368
166	Cheese Making on the Farm	20,000	7,960	8,452
167	Cassava	10,000	4,291	3,904
168	Pearl Millet	5,200	4,053	3.933
169	Experiment Station Work—XXII	15,300	5,273	5,962
170	Principles of Horse Feeding	63,100	44,856	13,377
172	Scale Insects and Mites on Citrus Trees	....	2,501	3,678
173	Primer of Forestry	60,200	18,907	40,142
174	Broom Corn	11,680	7,552	4,463
175	Home Manufacture and Use of Unfermented Grape Juice	15,797	8,421	11,382
176	Cranberry Culture	5,000	2,719	5,467

Farmers' bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1907–8—Continued.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
177	Squab Raising	35,000	12,750	14,934
178	Insects Injurious to Cranberry Culture	....	2,467	3,272
179	Horseshoeing	30,000	24,668	9,817
181	Pruning	35,000	23,960	18,784
182	Poultry as Food	40,250	18,143	13,825
183	Meat on the Farm: Butchering, Curing, and Keeping	60,500	41,134	17,105
185	Beautifying the Home Grounds	50,000	28,834	20,351
186	Experiment Station Work—XXIII	10,000	7,239	6,988
187	Drainage of Farm Lands	35,250	19,155	11,846
188	Weeds Used in Medicine	20,000	8,123	14,591
190	Experminent Station Work—XXIV	15,000	6,780	5,883
192	Barnyard Manure	45,300	21,206	16,698
193	Experiment Station Work—XXV	15,000	4,574	5,507
194	Alfalfa Seed	30,200	13,156	10,298
195	Annual Flowering Plants	60,000	21,310	12,724
196	Usefulness of the American Toad	16,000	6,719	7,931
197	Importation of Game Birds and Eggs for Propagation	10,000	5,798	4,493
198	Strawberries	40,500	21,406	18,378
199	Corn Growing	70,000	42,236	17,784
200	Turkeys: Standard Breeds and Management	42,250	27,083	16,125
201	The Cream Separator on Western Farms	20,200	8,892	8,982
202	Experiment Station Work—XXVI	5,943	7,512	5,595
203	Canned Fruits, Preserves, and Jellies	47,900	25,654	20,610
204	The Cultivation of Mushrooms	20,000	4,369	13,233
205	Pig Management.	52,490	32,713	13,557
206	Milk Fever and Its Treatment	15,000	5,562	8,247
208	Varieties of Fruits Recommended for Planting	41,200	24,177	14,842
209	Controlling the Boll Weevil in Cotton Seed and at Ginneries	10,000	7,104	2,988
210	Experiment Station Work—XXVII	10,000	6,517	5,874
211	The Use of Paris Green in Controlling the Cotton Boll Weevil	10,000	4,275	5,442
213	Raspberries	40,000	10,148	13,427
215	Alfalfa Growing	70,000	42,951	17,423
216	The Control of the Boll Weevil	10,026	16,348	3,820
217	Essential Steps in Securing an Early Crop of Cotton	40,300	28,220	6,367
218	The School Garden	36,000	19,791	12,909
219	Lessons from the Grain-Rust Epidemic of 1904	5,000	3,447	6,214
220	Tomatoes	60,300	29,961	17,995
221	Fungous Diseases of the Cranberry	10,000	1,816	3,019
222	Experiment Station Work—XXVIII	10,300	5,356	5,130
223	Miscellaneous Cotton Insects in Texas	7,000	2,982	4,141
224	Canadian Field Peas	10,000	4,301	5,795
225	Experiment Station Work—XXIX	20,200	11,105	8,672
226	Relation of Coyotes to Stock Raising in the West	10,100	4,131	3,751
227	Experiment Station Work—XXX	10,000	7,124	6,432
228	Forest Planting and Farm Management	30,000	12,619	10,681
229	The Production of Good Seed Corn	60,000	43,683	10,180
231	Spraying for Cucumber and Melon Diseases	15,000	5,582	6,562
232	Okra: Its Culture and Uses	5,000	4,647	6,500
233	Experiment Station Work—XXXI	5,000	6,603	5,335
234	The Guinea Fowl and Its Use as Food	20,000	9,536	10,654
235	Preparation of Cement Concrete	50,000	21,695	26,998
236	Incubation and Incubators	45,300	16,638	15,115
237	Experiment Station Work—XXXII	....	9,670	7,660
238	Citrus Fruit Growing in the Gulf States	10,700	5,917	4,665
239	The Corrosion of Fence Wire	35,000	19,308	7,888
240	Inoculation of Legumes	....	1,776	4,096
241	Butter Making on the Farm	65,800	47,366	14,420
242	An Example of Model Farming	40,000	30,383	15,537
243	Fungicides and Their Use in Preventing Diseases of Fruit	20,166	5,743	10,192
244	Experiment Station Work—XXXIII	20,300	7,554	7,300
245	Renovation of Worn-out Soils	45,200	26,129	12,707
246	Saccharine Sorghums for Forage	20,000	14,552	6,503
247	The Control of the Codling Moth and Apple Scab	20,000	7,016	7,780
248	The Lawn	40,000	19,880	9,773
249	Cereal Breakfast Foods	20,000	14,917	11,313
250	The Prevention of Stinking Smut of Wheat and Loose Smut of Oats	20,000	11,706	9,950
251	Experiment Station Work—XXXIV	15,000	7,820	5,174
252	Maple Sugar and Sirup	10,000	6,787	6,047
253	The Germination of Seed Corn	40,000	19,028	12,758
254	Cucumbers	16,000	8,219	11,891
255	The Home Vegetable Garden	100,000	76,959	24,440
256	Preparation of Vegetables for the Table	65,700	50,546	20,068
257	Soil Fertility	35,000	18,794	13,508
258	Texas or Tick Fever and Its Prevention	10,000	4,993	8,710
259	Experiment Station Work—XXXV	15,000	10,941	6,182

Farmers' bulletins printed and Congressional and miscellaneous distribution for the fiscal year 1907-8—Continued.

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
260	Seed of Red Clover and Its Impurities	30,000	15,986	6,452
261	The Cattle Tick	11,941	11,936	5,351
262	Experiment Station Work—XXXVI	15,000	11,146	9,678
263	Practical Information for Beginners in Irrigation	20,300	10,805	10,330
264	The Brown-tail Moth and How to Control It	5,000	3,092	4,014
265	Game Laws for 1906	....	2,432	3,384
266	Management of Soils to Conserve Moisture	55,000	37,506	14,036
267	Experiment Station Work—XXXVII	10,284	8,854	5,468
268	Industrial Alcohol: Sources and Manufacture	20,800	11,257	10,163
269	Industrial Alcohol: Uses and Statistics	15,000	7,492	10,771
270	Modern Conveniences for the Farm Home	45,500	33,375	14,022
271	Forage Crop Practices in Western Oregon and Western Washington	10,000	4,371	9,153
272	A Successful Hog and Seed Corn Farm	37,186	33,598	10,437
273	Experiment Station Work—XXXIII	20,200	12,558	5,762
274	Flax Culture	....	7,138	6,366
275	The Gipsy Moth and How to Control It	....	2,704	7,185
276	Experiment Station Work—XXXIX	10,000	9,917	5,605
277	The Use of Alcohol and Gasoline in Farm Engines	25,000	13,157	8,081
278	Leguminous Crops for Green Manuring	40,446	33,190	11,191
279	A Method of Eradicating Johnson Grass	20,500	12,947	6,489
280	A Profitable Tenant Dairy Farm	20,000	12,421	10,943
281	Experiment Station Work—XL	10,000	21,191	5,754
282	Celery	21,200	16,308	20,904
283	Spraying for Apple Diseases and the Codling Moth in the Ozarks	30,000	22,807	8,601
284	Insect and Fungous Enemies of the Grape East of the Rocky Mountains	15,000	5,605	11,780
285	The Advantage of Planting Heavy Cotton Seed	30,000	20,013	18,502
286	Comparative Value of Whole Cotton Seed and Cotton-Seed Meal in Fertilizing Cotton	40,200	12,011	25,570
287	Poultry Management	165,500	119,679	49,330
288	Nonsaccharine Sorghums	....	6,682	9,428
289	Beans	20,000	19,278	12,978
290	The Cotton Bollworm	6,537	11,448	14,781
291	Evaporation of Apples	10,000	10,784	10,180
292	Cost of Filling Silos	10,000	7,092	6,418
293	Use of Fruit as Food	45,250	31,738	9,587
294	Farm Practice in the Columbia Basin Uplands	15,000	4,106	8,801
295	Potatoes and Other Root Crops as Food	45,000	32,219	11,657
296	Experiment Station Work—XLI	25,000	23,564	11,874
297	Methods of Destroying Rats	30,000	18,758	23,288
298	The Food Value of Corn and Corn Products	35,000	38,204	11,485
299	Diversified Farming Under the Plantation System	20,000	15,750	8,199
300	Some Important Grasses and Forage Plants for the Gulf Coast Region	20,000	11,221	11,281
301	Home-grown Tea	5,000	6,464	12,669
302	Sea Island Cotton: Its Culture, Improvement, and Diseases	10,000	7,024	12,621
303	Corn Harvesting Machinery	45,000	24,137	12,494
304	Growing and Curing Hops	30,000	11,665	10,737
305	Experiment Station Work—XLII	30,000	14,952	11,369
306	Dodder in Relation to Farm Seeds	50,000	17,192	7,471
307	Roselle: Its Culture and Uses	15,200	3,171	10,112
308	Game Laws for 1907	60,000	19,955	34,298
309	Experiment Station Work—XLIII	30,000	12,774	13,996
310	A Successful Alabama Diversification Farm	25,000	6,690	10,730
311	Sand-clay and Burnt-clay Roads	30,000	20,708	9,292
312	A Successful Southern Hay Farm	25,372	15,562	9,810
313	Harvesting and Storing Corn	50,000	39,698	7,637
314	A Method of Breeding Early Cotton to Escape Boll Weevil Damage	25,129	14,709	8,135
315	Progress in Legume Inoculation	25,000	4,345	15,190
316	Experiment Station Work—XLIV	35,000	10,459	15,074
317	Experiment Station Work—XLV	40,000	26,033	10,649
318	Cowpeas	30,000	13,638	14,650
319	Demonstration Work in Cooperation with Southern Farmers	30,000	7,773	4,080
320	Experiment Station Work—XLVI	30,000	15,246	7,634
321	The Use of the Split-log Drag on Earth Roads	50,000	35,000	7,235
322	Milo as a Dry-land Grain Crop	10,000	2,000	5,464
323	Clover Farming on the Sandy Jack-pine Lands of the North	10,000	2,302	5,200
324	Sweet Potatoes	20,300	3,083	5,000
325	Small Farms in the Corn Belt	20,300	7,579	7,733
326	Building up a Run down Cotton Plantation	20,000	6,463	8,410
327	The Conservation of Natural Resources	30,000	4,204	4,275
		6,622,039	3,928,437	2,758,582

Publications received and distributed by the Weather Bureau during the year ended June 30, 1908.

Weather Bureau No.	Title of publication.	Number of copies.
	QUARTER ENDED SEPTEMBER 30, 1907.	
	Received.	
372	Thermodynamics of the Atmosphere. (Reprint from Monthly Weather Reviews)	1,500
373	Monthly Weather Review for May, 1907	4,900
374	Monthly Weather Review for June, 1907	4,900
375	Meteorological Charts of the Great Lakes, No. 2, 1906	2,000
376	Meteorological Charts of the Great Lakes, No. 1, 1907	2,500
377	Monthly Weather Review for July, 1907	4,900
	Washington Daily Weather Maps	119,240
	National Weather Bulletins	24,600
	Distributed.	
197	Bulletin No. 26—Lightning and Electricity of the Air	23
256	Bulletin No. 30—Loss of Life by Lightning	15
292	Bulletin L—Climate of California	5
294	Bulletin No. 33—Weather Folklore	4
303	Bulletin M—Floods of the Mississippi Valley, Spring of 1903	7
311	Bulletin No. 34—Climate, Its Physical Basis, etc	35
312	Invariability of Our Winter Climate	6
322	Bulletin No. 35—Long Range Weather Forecasts	37
326	Bulletin N—Periodic Variation of Rainfall in the Arid Regions	18
327	Evaporation Observations in the United States	5
334	Temperature and Relative Humidity Data	14
336	Improved Methods of Finding the Altitude, etc	9
338	Report of the Chief of Bureau, 1905	36
342	Bulletin No. 36—Relations Between Climates and Crops	5
349	Bulletin No. 37—Recent Practice in the Erection of Lightning Conductors	41
355	Bulletin P—Cold Waves and Frosts in the United States	29
361	Bulletin Q—Climatology of the United States	17
372	Thermodynamics of the Atmosphere. (Reprint from Monthly Weather Reviews)	1,000
373	Monthly Weather Review for May, 1907	4,900
374	Monthly Weather Review for June, 1907	4,900
375	Meteorological Charts of the Great Lakes, No. 2, 1906	1,900
376	Meteorological Charts of the Great Lakes, No. 1, 1907	2,400
377	Monthly Weather Review for July, 1907	4,900
	Washington Daily Weather Maps	119,240
	National Weather Bulletins	24,600
	Bulletin C	10
	Bulletin E	29
	Bulletin G	129
	Bulletin H	4
	Annual Report of Chief of Bureau, 1901-2	5
	Annual Report of Chief of Bureau, 1903-4	2
	Annual Report of Chief of Bureau, 1904-5	1
	QUARTER ENDED DECEMBER 31, 1907.	
	Received.	
378	Monthly Weather Review for August, 1907	4,900
379	Annual Report of Chief of Bureau, 1907	3,000
380	Monthly Weather Review for September, 1907	4,900
	Washington Daily Weather Maps	123,735
	National Weather Bulletin	7,450
	Snow and Ice Bulletin	6,080
	Annual Report of Chief of Bureau, 1905-6	1,000
	Distributed.	
197	Bulletin No. 26—Lightning and Electricity of the Air	41
256	Bulletin No. 30—Loss of Life by Lightning	8
292	Bulletin L—Climate of California	11
301	Climatic Charts	11
303	Bulletin M—Floods of the Mississippi Valley, Spring of 1903	23
311	Bulletin No. 34—Climate, Its Physical Basis, etc	110
312	Invariability of Our Winter Climate	5
322	Bulletin No. 35—Long Range Weather Forecasts	146
326	Bulletin N—Periodic Variation of Rainfall in the Arid Regions	78
327	Evaporation Observations in the United States	4
334	Bulletin O—Temperature and Relative Humidity Data	37
336	Improved Methods of Finding the Altitude, etc	3
338	Report of the Chief of Bureau, 1905	62
342	Bulletin No. 36—Relations Between Climates and Crops	7
349	Bulletin No. 37—Recent Practice in the Erection of Lightning Conductors	86
355	Bulletin P—Cold Waves and Frosts in the United States	70
361	Bulletin Q—Climatology of the United States	11
372	Thermodynamics of the Atmosphere. (Reprint from Monthly Weather Reviews)	89

Publications received and distributed by the Weather Bureau during the year ended June 30, 1908—Continued.

Weather Bureau No.	Title of publication.	Number of copies.
	QUARTER ENDED DECEMBER 31, 1907—continued.	
	Distributed—Continued.	
378	Monthly Weather Review for August, 1907	4,900
379	Annual Report of Chief of Bureau, 1907	2,300
380	Monthly Weather Review for September, 1907	4,900
	Annual Report of Chief of Bureau, 1905–6	800
	Washington Daily Weather Maps	123,735
	National Weather Bulletins	7,450
	Snow and Ice Bulletins	6,080
	Bulletin C	16
	Bulletin G	3
	Bulletin H	2
	Annual Report of Chief of Bureau, 1891–92	3
	Annual Report of Chief of Bureau, 1893	3
	Annual Report of Chief of Bureau, 1894	2
	Annual Report of Chief of Bureau, 1895	4
	Annual Report of Chief of Bureau, 1896–97	3
	Annual Report of Chief of Bureau, 1897–98	6
	Annual Report of Chief of Bureau, 1899–1900	3
	Annual Report of Chief of Bureau, 1900–1901	5
	Annual Report of Chief of Bureau, 1901–2	9
	Annual Report of Chief of Bureau, 1902–3	4
	Annual Report of Chief of Bureau, 1903–4	5
	Annual Report of Chief of Bureau, 1904–5	8
	QUARTER ENDED MARCH 31, 1908.	
	Received.	
381	Bulletin of the Mount Weather Observatory, Part I	1,200
382	Monthly Weather Review for October, 1907	4,750
383	Monthly Weather Review for November, 1907	4,750
384	Monthly Weather Review for December, 1907	4,750
385	Monthly Weather Review, Annual Summary, 1907	4,750
386	Monthly Weather Review for January, 1908	4,750
	Washington Daily Weather Maps	124,360
	National Weather Bulletin	7,950
	Snow and Ice Bulletin	17,080
	Distributed.	
197	Bulletin No. 26—Lightning and Electricity of the Air	23
256	Bulletin No. 30—Loss of Life by Lightning	13
292	Bulletin L—Climate of California	16
301	Climatic Charts of the United States	12
303	Bulletin M—Floods of the Mississippi Valley, Spring of 1903	15
311	Bulletin No. 34—Climate, Its Physical Basis, etc	21
312	Invariability of our Winter Climate	6
322	Bulletin No. 35—Long Range Weather Forecasts	74
326	Bulletin N—Periodic Variation of Rainfall in the Arid Regions	43
327	Evaporation Observations in the United States	13
334	Bulletin O—Temperature and Relative Humidity Data	51
336	Improved Methods for Finding the Altitude, Azimuth, etc	8
338	Report of the Chief of Bureau, 1905	27
342	Bulletin No. 36—Relations Between Climates and Crops	12
349	Bulletin No. 37—Recent Practice in the Erection of Lightning Conductors	27
355	Bulletin P—Cold Waves and Frosts in the United States	35
361	Bulletin Q—Climatology of the United States	3
372	Thermodynamics of the Atmosphere. (Reprints from Monthly Weather Reviews)	25
379	Report of the Chief of Bureau, 1907	75
381	Bulletin of the Mount Weather Observatory, No. 1, Part I	800
382	Monthly Weather Review for October, 1907	4,750
383	Monthly Weather Review for November, 1907	4,750
384	Monthly Weather Review for December, 1907	4,750
385	Monthly Weather Review, Annual Summary, 1907	4,750
386	Monthly Weather Review for January, 1908	4,750
	Washington Daily Weather Maps	124,360
	National Weather Bulletin	7,950
	Snow and Ice Bulletin	17,080
	Annual Report of Chief of Bureau, 1899–1900	3
	Annual Report of Chief of Bureau, 1900–1901	7
	Annual Report of Chief of Bureau, 1901–2	7
	Annual Report of Chief of Bureau, 1902–3	9
	Annual Report of Chief of Bureau, 1903–4	10
	Annual Report of Chief of Bureau, 1904–5	9
	Annual Report of Chief of Bureau, 1905–6	17

Publications received and distributed by the Weather Bureau during the year ended June 30, 1908—Continued.

Weather Bureau No.	Title of publication.	Number of copies.
	QUARTER ENDED JUNE 30, 1908.	
	Received.	
387	Monthly Weather Review for February, 1908	4,800
388	Mount Weather Observatory Bulletin, Part II	1,200
389	Monthly Weather Review for March, 1908	4,800
390	Monthly Weather Review for April, 1908	4,800
	Washington Daily Weather Maps	118,643
	National Weather Bulletins	21,280
	Distributed.	
197	Bulletin No. 26—Lightning and Electricity of the Air	47
256	Bulletin No. 30—Loss of Life by Lightning	27
292	Bulletin L—Climate of California	18
301	Climatic Charts	7
303	Bulletin M—Floods of the Mississippi Valley, Spring of 1903	21
311	Bulletin No. 34—Climate, Its Physical Basis, etc	14
312	Invariability of Our Winter Climate	5
322	Bulletin No. 35—Long Range Weather Forecasts	32
326	Bulletin N—Periodic Variation of Rainfall in the Arid Regions	210
327	Evaporation Observations in the United States	10
334	Bulletin O—Temperature and Relative Humidity Data	46
336	Improved Methods of Finding Altitude, etc	4
338	Report of the Chief of Bureau, 1905	12
342	Bulletin No. 36—Relations Between Climates and Crops	14
349	Bulletin No. 37—Recent Practice in Erection of Lightning Conductors	124
355	Bulletin P—Cold Waves and Frosts in the United States	16
361	Bulletin Q—Climatology of the United States	9
372	Thermodynamics of the Atmosphere. (Reprints from Monthly Weather Reviews)	25
379	Annual Report of the Chief of Bureau, 1907	19
381	Mount Weather Observatory Bulletin, Vol. I, Part I	35
387	Monthly Weather Review for February, 1908	4,800
388	Mount Weather Observatory Bulletin, Vol. I, Part II	1,000
389	Monthly Weather Review for March, 1908	4,800
390	Monthly Weather Review for April, 1908	4,800
	Washington Daily Weather Maps	118,643
	National Weather Bulletins	21,280
	Bulletin C, 10 copies; Bulletin G, 9 copies; Bulletin H, 6 copies; total	25
	Annual Report of Chief of Bureau, 1891-92	2
	Annual Report of Chief of Bureau, 1893	3
	Annual Report of Chief of Bureau, 1894	1
	Annual Report of Chief of Bureau, 1895-96	4
	Annual Report of Chief of Bureau, 1896-97	2
	Annual Report of Chief of Bureau, 1897-98	3
	Annual Report of Chief of Bureau, 1898-99	2
	Annual Report of Chief of Bureau, 1899-1900	1
	Annual Report of Chief of Bureau, 1900-1901	4
	Annual Report of Chief of Bureau, 1901-2	8
	Annual Report of Chief of Bureau, 1902-3	4
	Annual Report of Chief of Bureau, 1903-4	4
	Annual Report of Chief of Bureau, 1904-5	5
	Annual Report of Chief of Bureau, 1905-6	12

REPORT OF THE ACTING CHIEF OF THE BUREAU OF STATISTICS.

U. S. Department of Agriculture,
Bureau of Statistics,
Washington, D. C., September 24, 1908.

Sir: I have the honor to submit herewith the report of the Bureau of Statistics for the fiscal year ended June 30, 1908.

Very respectfully,

C. C. Clark,
Acting Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

ORGANIZATION.

Leave of absence has been granted during the year to Mr. Victor H. Olmsted, Statistician and Chief of Bureau, to enable him to take the census of Cuba, and during his absence Mr. C. C. Clark, the Associate Statistician, has been Acting Chief of Bureau and chairman of the Crop Reporting Board.

DIVISION OF PRODUCTION AND DISTRIBUTION.

The organization of the Bureau of Statistics has undergone a change so far as it relates to the division formerly known as "Foreign Markets," the work of which has become larger in scope. That division has been named the "Division of Production and Distribution" and is now concerned with the production of wealth on farms, with the distribution of farm products at home and abroad, and with the economic conditions pertaining to the agricultural element of the population. The scope and variety of its work are indicated by such subjects as the production and consumption of meat and the foreign markets for the national surplus of meat; farmers' cooperative organizations for insuring against loss by fire, for buying supplies, for selling products, etc.; the problems of the production and consumption of wheat in the chief countries; statistical compilations of the number of domestic animals in most of the countries of the world, of the foreign trade of the United States in agricultural products, of crop production in many countries, of agricultural exports and imports for all countries for which the information is published; a chronological record of the principal events that have marked the progress and improvement of agriculture in the United States;

changes in farm values and the causes thereof; questions involved in the transportation of farm products by rail, inland waterways, ocean, and wagon; compilations and revisions for other Bureaus.

EDITORIAL DIVISION AND LIBRARY.

During the past year the branch of the Bureau formerly known as the "Miscellaneous Division," has also been reorganized, and, in order to describe its functions under the reorganization more definitely, it has been named the "Editorial Division and Library." Obvious reasons for reorganization were: (1) A notable increase over that of any previous year in the number of publications prepared in and issued from the Bureau; (2) a constant growth in the closely allied work of research and compilation incident to compliance with requests from statesmen, economists, statisticians, educational institutions, commercial and agricultural organizations, departments of the Federal, State, and foreign governments, and from private individuals for statistical and cognate data; (3) increased work in the administration of the Bureau's library, due primarily to continuous accessions of foreign, Federal, State, and municipal statistical literature, the voluminous publication of which in almost every civilized country has now become a well-known characteristic of the age; and (4) consequent additions to the typewriting and stenographic work of the division.

The editorial work proper, which, it may be noted, has been undertaken largely with the object of securing accuracy, consistency, and uniformity of statistical expression, has consisted chiefly of editing the following publications: (1) The eleven bulletins covering various phases of domestic and foreign agricultural and commercial statistics which have issued from the Bureau during the year; (2) the monthly editions of the Crop Reporter, the official organ of the Bureau; (3) the statistical tables prepared in the Bureau for publication in the 1907 edition of the Yearbook of the Department, and, separately, under the title "Agricultural Statistics, 1907;" and (4) manuscripts of a miscellaneous character adjunct to the Bureau's routine work.

The functions of the division in respect of the Bureau's correspondence have consisted principally of complying with numerous and increasing requests for statistical and technical data relating to domestic and foreign agriculture. This diversified class of work has involved extensive research of statistical and other publications, and the compilation of data therefrom, for the purpose of responding to hundreds of written and verbal requests for varied information concerning foreign and domestic agricultural areas, yields, numbers of farm animals, cost of production, prices of and commerce in agricultural products, fiscal laws relating to commerce and production, migratory movements of farm laborers, uses of agricultural products, number of farm implements in use, and divers other phases of the agricultural industry. Compilations have also been made in this division during the year, for publication in the Yearbook, of the world's production, by countries, of corn, wheat, oats, rye, barley, and flaxseed.

STATISTICAL LIBRARY.

The statistical library, which furnishes the basis for an important part of the division's work, has now increased to about 10,000 volumes, and, in point of the number devoted more or less exclusively to statistics of agriculture, is probably exceeded by few, if any, similar collections. From the fact that statistical literature is for the most part periodical, the bulk of the collection consists of constantly growing sets of annual publications which may be classified along broad lines as follows:

Annual official statistical reports on the agriculture of various foreign governments.

Annual statistical and other publications of the Departments and Bureaus of the United States Government.

Annual reports of State boards and departments of agriculture and of State auditors.

Annual reports of chambers of commerce and boards of trade.

Federal and State censuses.

Bound volumes, for a series of years, of leading trade journals.

Miscellaneous publications, chiefly of a statistical character.

A large number of daily, weekly, and monthly foreign and domestic periodicals, price lists, etc., are also received, either through exchange or purchase.

The routine work of administering the library naturally increases from year to year as accessions to the shelves and public demands for statistical data multiply. In each respect the past year has probably been a record one. By virtue of the recent change of location, moreover, the entire library has been rearranged and reclassified. A thorough revision and wide extension of the card-index system has been undertaken and is well under way toward completion. The especial object of this work has been to make the wealth of statistical data relating to the agriculture of the various countries of the world, now in possession of the Bureau, easily and quickly accessible. The exchanges and trade journals received have also been catalogued, so far as statistics of agriculture are concerned, thereby affording prompt access to current statistical literature of the day not available in annual publications.

NEW OFFICES OF THE BUREAU.

The assignment to this Bureau of the large hall in the old administration building, vacated by the Department's Library, besides permitting a more direct supervision by yourself of the crop-reporting work, has enabled it to effect a long-desired and much-required rearrangement of its work, and to assemble its entire clerical force in one building. By partitioning this large room, 50 feet by 100 feet, it has been possible to concentrate in one room the fifty or more clerks engaged in the compilation and tabulation of the reports of the county, township, and special correspondents, used in the preparation of the Bureau's crop reports. A similar advantage has been gained for the Bureau's library by assigning to it the north gallery, 100 feet by 15 feet. Its volumes are now arranged on convenient modern metal stacks of the same type as those in use in the Department's Library and the Library of Congress.

The Division of Production and Distribution occupies adjoining rooms in the east wing of the building, and thereby secures a more convenient and compact organization with the Bureau.

VOLUME OF CORRESPONDENCE.

Incident to the recent extension of the Bureau's work, there has been a heavy increase in the volume of mail handled. During the past year not less than 2,000,000 letters and over 500,000 packages of publications have passed through the mailing section; in addition, 1,700,000 copies of the Crop Reporter and a large number of bulletins and circulars have been distributed through the Division of Publications.

An improved method of maintaining an efficient corps of township correspondents has been adopted, and persons, who through failure to furnish prompt and full reports have shown a lack of interest in the work, have been dropped from the rolls. The result has been a material improvement in this branch of the crop-reporting service, the average number of reports received in time for tabulation having increased from about 50 per cent of the total in 1905 to about 70 per cent in recent months. Moreover, the lists of correspondents, now about 150,000 in number, which the Bureau maintains for the purpose of collecting crop statistics, have been augmented by names of reliable and representative farmers named by members of Congress, in prompt response to requests of the Statistician, from among their constituents.

CONTENTS OF REPORTS AND TIME OF ISSUANCE.

REPORTS ISSUED ON EARLIER DATES.

Successful efforts have been made to secure the earlier publication of the monthly crop reports, so that the information contained therein may be disseminated nearer the dates to which the reports relate. The reports as to cotton relate to the 25th of the month, and were formerly published on the 3d of the following month; this year their publication on the 1st or 2d has been secured, and it is believed that the date of publication may hereafter be made not later than the 1st of each month. The reports as to grain and other products which relate to the 1st of each month were formerly published on the 10th; this year their publication has been made on the 8th or 9th, and it is expected to effect their publication not later than the 7th or 8th. The earlier publication of the reports has been secured by simplifying methods of tabulation and improving the organization of the Bureau.

DATES OF PUBLICATION AND CONTENTS OF REPORTS.

The dates of publication of the reports, and their contents, are as follows:

July 2, 12 o'clock noon: Condition of cotton on June 25.

July 10, 2 p. m.: Acreage and condition on July 1 of corn, rice, flaxseed, sorghum, tobacco, potatoes, and sweet potatoes; condition on July 1 of broom corn, barley, oats, rye, spring wheat, winter wheat, alfalfa, bluegrass for seed, Canadian peas, clover for hay, cowpeas, hay, kafir corn, millet, pastures, timothy, apples, blackberries, cantaloupes and muskmelons, grapes, lemons, oranges, peaches, raspberries, strawberries, watermelons, hemp, hops, peanuts, sugar beets, sugar cane, dry beans, lima beans, cabbages, onions, and tomatoes; stock of wheat in farmers' hands July 1; weight of wool per fleece.

August 2, 12 o'clock noon: Condition of cotton on July 25.

August 9, 2 p. m.: Condition on August 1 of broom corn, barley, corn, rice, rye, spring wheat, alfalfa, bluegrass for seed, Canadian peas, cowpeas, kafir corn, millet, pastures, timothy, apples, cantaloupes and muskmelons, grapes, lemons, oranges, peaches, watermelons, flaxseed, hemp, hops, peanuts, sorghum, sugar beets, sugar cane, tobacco, dry beans, lima beans, cabbages, onions, potatoes, sweet potatoes, and tomatoes; acreage and condition on August 1 of buckwheat; stock in farmers' hands and condition of oats; yield and quality of winter wheat; production, in percentage, and quality of clover for hay; acreage of hay; production, in percentage, of blackberries and raspberries.

September 9, 11 a. m.: Condition of cotton on August 25, being the same date as report on amount of cotton ginned to September 1, issued by the Census Bureau, as required by law.

September 10, 1 p. m.: Condition on September 1 of broom corn, barley, buckwheat, corn, oats, rice, spring wheat, alfalfa, Canadian peas, cowpeas, kafir corn, millet, apples, cranberries, grapes, lemons, oranges, watermelons, flaxseed, hemp, hops, peanuts, sorghum, sugar beets, sugar cane, tobacco, dry beans, lima beans, cabbages, onions, potatoes, sweet potatoes, and tomatoes; acreage harvested, yield, and quality of rye; production, in percentage, of bluegrass seed, cantaloupes and muskmelons, and peaches; acreage and condition of clover for seed September 1; number of stock hogs and condition of swine September 1.

October 2, 11 a. m.: Condition of cotton on September 25.

October 9, 1 p. m.: Production, in percentage, of broom corn, alfalfa, clover for seed, watermelons, hemp, dry beans, lima beans, cabbages, onions, and tomatoes; yield and quality of barley, oats, spring wheat, hay, and hops; condition of buckwheat, corn, rice, cowpeas, apples, cranberries, grapes, lemons, oranges, flaxseed, peanuts, sorghum, sugar beets, sugar cane, tobacco, potatoes, and sweet potatoes; production of forage and grain of millet; production of forage of kafir corn.

November 8, 1 p. m.: Yield and quality of buckwheat, flaxseed, tobacco, potatoes and sweet potatoes. Yield, quality, and stock of corn in hands of farmers; yield of rice and sorghum; production of apples, cranberries, grapes, pears, and peanuts; condition of lemons, oranges, sugar beets, and sugar cane expressed in percentages.

December 9, 1 p. m.: Newly seeded area and condition on December 1 of winter wheat and winter rye.

December 10, 1 p. m.: Estimated total production of cotton, by States, for the year.

December 20, 2 p. m.: Final estimates of acreage, production and value of corn, spring wheat, winter wheat, oats, barley, rye, buckwheat, flaxseed, rice, potatoes, hay, and tobacco, and the average natural weight per bushel of spring wheat, winter wheat, and oats.

February 1, 2 p. m.: Number and value on January 1 of horses, mules, milch cows, other cattle, sheep, and swine.

March 9, 2 p. m.: Stocks of corn, oats, and wheat on farms March 1, and amount shipped out of counties where grown; proportion of corn crop merchantable.

April 8, 11 a. m.: Condition of rye, winter wheat, horses, cattle, sheep, and swine; losses by disease and exposure during year of horses, cattle, sheep, and swine; number of breeding sows on April 1.

May 8, 12 o'clock noon: Condition on May 1 of rye, winter wheat, meadows and pastures; acreage of winter wheat abandoned; per cent of plowing and planting done.

June 2, 12 o'clock noon: Acreage and condition of cotton on May 25, by States.

June 8, 2 p. m.: Acreage and condition on June 1 of barley, oats, spring wheat, clover for hay, and sugar cane; condition on June 1 of rye, winter wheat, alfalfa, bluegrass for seed, Canadian peas, cowpeas, hay, pastures, apples, blackberries, cantaloupes and muskmelons, peaches, raspberries, watermelons, sugar beets, lima beans, hemp, cabbages and onions; production of asparagus, expressed in percentages.

CROP REPORTING BOARD.

The plan of intrusting the final preparation of reports to a crop-reporting board has been continued during the past year, and after three full years of trial it has been demonstrated that this is an excellent and satisfactory method. It relieves one man of the strain and responsibility, and secures the benefits of consultation and a consensus of judgment of men who have been on the ground.

The Crop Reporting Board is composed of the Chief of Bureau as chairman, and four other members, whose services are brought into requisition each crop-reporting day from among the statisticians and officials of the Bureau, and the special field and State statistical agents who are called to Washington for the purpose.

The personnel of the board is changed each month. The meetings are held in the office of the Statistician, which is kept locked during the sessions, no one being allowed to enter or leave the room or the Bureau and all telephones being disconnected.

The names of the members who have composed each of the boards during the past year are as follows:

July 2, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; F. W. Gist, special field agent for Oklahoma and north Texas; and T. C. Shaw, special field agent for Georgia and Florida.

July 10, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; John J. Darg, special field agent for New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia; and McKenzie R. Todd, State statistical agent for Kentucky.

August 2, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; James H. Lane, State statistical agent for Alabama; and W. A. Withers, State statistical agent for North Carolina.

August 9, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; John J. Darg, special field agent for New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia; and A. G. McCall, State statistical agent for Ohio.

September 9, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; H. T. Bradford, special field agent for Arkansas and Louisiana; and W. J. Northen, State statistical agent for Georgia.

September 10, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; Herman H. Johnson, special field agent for Ohio, Kentucky, Michigan, Indiana, and Illinois; and W. C. Duncan, State statistical agent for Indiana.

October 2, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; S. A. Knapp, State statistical agent for Louisiana; and C. D. Boardman, State statistical agent for Oklahoma.

October 9, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; Frank S. Pinney, special field agent for Wisconsin, Iowa, and Nebraska; and John Cownie, State statistical agent for Iowa.

November 8, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; Herman H. Johnson, special field agent for Ohio, Kentucky, Michigan, Indiana, and Illinois; and John J. Darg, special field agent for New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia.

December 9, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; Herman H. Johnson, special field agent for Ohio, Kentucky, Michigan, Indiana, and Illinois; and Leslie E. Wallace, special field agent for Missouri and Kansas.

December 10, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; W. L. Pryor, special field agent for Alabama, Mississippi, and Tennessee; and Jefferson Johnson, State statistical agent for Texas.

December 20, 1907: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; and J. P. Killebrew, tobacco expert.

February 1, 1908: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; John J. Darg, special field agent for New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia; and F. W. Gist, special field agent for Oklahoma and North Texas.

March 9, 1908: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; John J. Darg, special field agent for New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia; Herman H. Johnson, special field agent for Ohio, Kentucky, Michigan, Indiana, and Illinois; and Heber M. Creel, special field agent for Minnesota, North Dakota, South Dakota, and Montana.

April 8, 1908: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; John J. Darg, special field agent for New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia; and Leslie E. Wallace, special field agent for Missouri and Kansas.

May 8, 1908: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; Frank S. Pinney, special field agent for Wisconsin, Iowa, and Nebraska; and R. A. Stewart, State statistical agent for West Virginia.

June 2, 1908: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; W. L. Pryor, special field agent for Alabama, Mississippi, and Tennessee; and Jefferson Johnson, State statistical agent for Texas.

June 8, 1908: C. C. Clark, Acting Chief of Bureau, chairman; Nat C. Murray, Assistant Statistician; George K. Holmes, statistical scientist; A. F. Hitt, special field agent for Idaho, Washington, and Oregon; and P. A. Rogers, State statistical agent for Minnesota.

PUBLICATIONS.

In response to numerous inquiries for a description of the crop-reporting methods, there has been prepared a circular entitled "Government Crop Reports, Their Scope, Value, and Methods of Preparation," which gives details of the Bureau's methods and refers to the value and necessity for a Federal crop-reporting service. An edition of 50,000 is being printed for general distribution.

During the past year there was begun the collection of information concerning farmers' cooperative organizations, of which there are an immense number in this country, embracing more than half of the farmers. The undertaking is a large one and will require several years for completion.

A compilation of the agricultural imports of the United States beginning with 1851 was completed. A similar compilation of agricultural exports was made five years ago, and recently the statistics of the reexports of agricultural imports, or the so-called "foreign exports" were compiled for the same period, so that the entire foreign trade in every agricultural community for more than half a century will soon be made available to the public.

A demand for information contained in Bulletin No. 40, "Meat Animals and Packing-house Products Imported into Eleven Principal Countries, 1895–1904," has been so great that the statistics for 1905 and 1906 have been compiled, so that the latest information from foreign countries may be readily available.

The statement of the acreage, production, and foreign trade in tobacco of the American colonies and of the United States from the earliest times to the present year was undertaken and nearly accomplished. This statement is regarded as the most complete one ever prepared for this crop and required a large amount of research in this country and in England.

An extensive investigation of the production, trade, and supply of wheat in principal countries was commenced. The plan is to give special attention to conditions in countries which export wheat and to the consumption and markets in the principal importing countries.

This work continues the general subject treated in the bulletins on Russian grain (42, 65, and 66) and the two on cereals in Europe (68 and 69).

The results of investigation of methods and cost of carrying farm products on inland waterways were reported in an article in the Yearbook for 1907. Material for this article was obtained chiefly through personal inquiries made at shipping points and on board boats on Chesapeake Bay and the Tennessee River.

A compilation of the imports of farm products into the Netherlands for the years 1904–1906 was prepared for publication as a bulletin. The quantity of durum wheat exported from the United States in the fiscal year 1907 was ascertained from reports received from correspondents at the leading grain markets and seaports; the first report of this kind was prepared for 1906. What is substantially the world's production of wool was ascertained with much difficulty for inclusion in the agricultural statistics of the Yearbook of 1907. This is the first publication of this information by the Department.

STATISTICS OF TOBACCO BY TYPES.

The Bureau is bringing to a successful culmination a plan by which it is hoped to secure statistics of tobacco production by types. The State is the smallest unit or geographical division for which the Bureau issues detailed reports comparable with similar reports which have been prepared for a long series of years. By this method there can be secured statistics of the amount of different types of tobacco grown in the States where more than one type of tobacco is raised. In the New England States, New York, Pennsylvania, Georgia, Florida, and Wisconsin, where the type of tobacco grown is coextensive with State lines, the amount of each type may be estimated; but in the States of Kentucky, Tennessee, Ohio, Virginia, and the Carolinas, where more than one distinct type grows within the State, it is very difficult to segregate the line of counties that separate the types, unless a regular county enumeration be made.

In order to overcome this handicap, this Department has entered into cooperation with the Treasury Department, through its Bureau of Internal Revenue, which has inserted in the reports made by dealers in leaf tobacco a requirement for the amount received from farmers. By these data the Bureau will be enabled to check the annual reports and to secure a valuable statement by types.

RECOMMENDATIONS.

ENLARGEMENT OF FIELD SERVICE.

The gradual increases which have been made by Congress in the Bureau's appropriations for the past several years have been used to very excellent advantage, and it is suggested that a small increase in the number of special field agents will result in still further perfecting the work of the Bureau. It would make it possible to lessen the number of States which some of these agents are now required to travel over continually, and enable them to cover the territory assigned in greater detail and more thoroughly.

TRAVEL OF STATE STATISTICAL AGENTS.

Excellent results have been accomplished through the travel which has been performed by the State agents throughout their respective States, and it is believed that the allotment of increased amounts will be productive of good results and secure greater accuracy in their reports. It will also make it possible to bring these agents to Washington, D. C., for more frequent conferences and instructions.

IMPROVED METHODS OF SECURING ACREAGE STATISTICS.

It is desired to extend the preliminary investigations which have been made in regard to improving methods of collecting statistics of acreages of the principal crops. The plan is to secure more detailed information by using certain counties in each State as units and having them traveled by local agents.

REPORT OF THE LIBRARIAN.

U. S. Department of Agriculture,
Office of the Librarian,
Washington, D. C., September 15, 1908.

Sir: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1908.

Respectfully,

Claribel R. Barnett,
Librarian.

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE YEAR.

The moving of the Library from the main building, where it has been housed since 1868, to the new building for the Department marks the last fiscal year as a memorable one in the history of the Library. In his account of the Library, written in 1897, Mr. W. P. Cutter states that "in 1868 the building for the then recently created Department of Agriculture having been completed, the books on agricultural subjects which had been collected by the Division of Agriculture when part of the Patent Office were transferred to rooms set apart for them in the new Department building." The collection, which numbered less than 1,000 volumes at that time, had grown to a collection of nearly 100,000 volumes when transferred to the new Department building of 1908. About two-thirds of the present collection was contained in the main Library in the main building at the time of its removal, which began on March 26 and was finished on May 20, 1908. During this time there was no interruption in the circulation of the books and periodicals. The records kept at the loan desk show that the number of books borrowed during this time was very little less than the number borrowed during the same period in the preceding fiscal year in spite of the fact that the work of many of the offices was interrupted by their removal to the new building. The Library now occupies 18 rooms in the basement of the east wing of the new building, of which number 11 are filled with book stacks, 5 are used as work and office rooms, 1 is used as a reading room for current periodicals, and 1 as a reference room. The crowded condition which existed in the old building is for the present relieved, though additional room will soon be needed. It is a matter for congratulation that the Library is now stored in a fire-proof building, as it would mean an almost irreparable loss to the Department if the Library's collections were destroyed.

ADDITIONS TO THE LIBRARY.

The number of books and pamphlets added to the Library during the fiscal year ending June 30, 1908, amounted to 4,340. The total recorded number of books and pamphlets in the Library on July 1, 1908, was 100,000. Although the Library appropriation for the last fiscal year exceeded that of the preceding year by $2,500, there was no corresponding increase in the number of additions to the Library by reason of the fact that it was necessary to spend four-fifths of the above increase in the purchase of new library shelving made necessary by the removal of the Library to the new building.

The expenditures of the Library, exclusive of salaries, are shown below:

Books	$5,320.87
Periodicals (subscriptions)	2,739.51
Serials	1,268.62
Printed cards	141.45
Shelving	2,080.70
Supplies	264.85
Furniture and fittings	407.15
Traveling expenses	78.25

As in previous years, the Library has been the recipient of many valuable gifts and exchanges from authors, publishers, periodicals, institutions, and societies. It is regretted that space will not permit a list of the donors to be given. If arranged geographically the list would show that exchanges are received from nearly every country in the world.

CATALOGUING.

The number of new cards added to the Library's catalogue during the year was 18,044. It is estimated that the main (dictionary) catalogue now contains about 203,000 cards. In March, 1908, the Library, through the courtesy of the Librarian of Congress, was made a partial depository of the Library of Congress cards, which arrangement has proved a great advantage to this Library. The routine work of the cataloguing as well as all the routine work of the Library was greatly interrupted during the eight weeks devoted to the moving, since it was necessary for the various members of the staff to devote a large part of their time to the supervision of laborers engaged in moving the books and placing them on the shelves. On this account it was impossible during the last year to make an addition to the printed subject lists of the Library.

CATALOGUE CARDS FOR DEPARTMENT PUBLICATIONS.

The printing of catalogue cards for the Department publications, with the cooperation of the Library of Congress, in accordance with the plan described in the Report of the Librarian for 1906, has been continued, and during the past year cards for all the current Department publications have been printed. Inasmuch as the supply of cards issued by this Library previous to 1906 is exhausted and the demand for them is increasing, it is recommended that during the coming year all of the cards issued before that date be revised and reprinted, the revising to be done by this Library and the printing by the Library of Congress.

INDEXING AGRICULTURAL LITERATURE.

During the year the Library has indexed on cards the current numbers of the following important foreign agricultural periodicals, namely: Die Landwirtschaftlichen Versuchsstationen, Landwirtschaftliche Jahrbücher, and Annales de la Science Agronomique. These periodicals had previously been indexed from the beginning of each set, and the printed cards are available for purchase at a moderate cost.

PERIODICALS.

The number of different scientific and technical periodicals and serials currently received in the Library during the last fiscal year was 1,851, exclusive of annual reports of societies and institutions. Of this number a little less than a third were received by purchase and the remainder by gift and exchange.

BINDING.

The number of volumes bound in the last year was 2,209, a decrease of 8 as compared with the preceding year. It is a source of much regret that the funds available for binding have never been sufficient to meet the needs of the Library. The number of periodicals currently received by the Library has been steadily increasing from year to year, whereas the sums available for the binding and preservation of these periodicals have been decreasing during the last two years. The binding of periodicals is not only essential for their preservation but it also increases their usefulness by 50 per cent, and it is hoped that the sums available for the next fiscal year will be made sufficient not only to bind the current periodicals but also to reduce to a considerable degree the arrears in binding which have accumulated during several years.

LIBRARY PUBLICATIONS.

The publication of the quarterly bulletin entitled "Accessions to the Department Library" has been continued, and the four numbers of the last year (Bulletins 65–68) comprise 243 pages.

USE OF THE LIBRARY.

During the last fiscal year the charges made at the loan desk numbered 22,470, an increase of 3,409 as compared with the preceding year. These statistics do not include a record of the circulation of the single unbound numbers of periodicals, nor do they include a record of the daily use of books deposited in the several Bureaus and Divisions of the Department, nor a record of the books used in the main Library reading room but not taken out of the Library, and therefore not charged at the loan desk. No accurate record is kept of the circulation of single unbound periodicals, but it is estimated that more than 50,000 numbers were circulated during the year.

It is gratifying to be able to report that the use of the Library by scientists outside of Washington is increasing from year to year. The number of books borrowed during the year by scientists outside of the city was 381, an increase of 141 as compared with the preceding year. The circulation by States was as follows: Alabama, 1; Alaska, 2; Arkansas, 1; Arizona, 18; California, 6; Colorado, 2; Connecticut, 15; Delaware, 1; Florida, 56; Georgia, 1; Hawaii, 11; Illinois, 9; Indiana, 7; Kansas, 1; Louisiana, 8; Maine, 7; Maryland, 16; Massachusetts, 35; Michigan, 4; Minnesota, 11; Missouri, 7; Nebraska, 6; New Hampshire, 4; New York, 55; North Carolina, 24; North Dakota, 3; Ohio, 4; Oregon, 9; Pennsylvania, 18; Porto Rico, 1; Tennessee, 5; Texas, 4; Virginia, 13; Vermont, 4; Washington, 9, and Wisconsin, 13.

As in past years, the Library has made frequent use of the Library of Congress and of the libraries of the Surgeon-General's Office, Patent Office, Geological Survey, Smithsonian Institution, National Museum, and other Government offices. We have also enjoyed the privilege of borrowing books from university and reference libraries in other cities. To all of the above libraries special thanks are due for the many favors that have been received.

RECOMMENDATIONS.

In order that the Library may keep pace with the growth of the Department and more fully meet the demands that are made upon it, an increase in the appropriation available for the purchase of books is most earnestly recommended.

In connection with the appropriation for the salaries of the Library staff, your attention is called to the present method of payment of the salaries of the librarians in charge of the books deposited in the Bureaus and Divisions of the Department. At present their salaries are paid by the Bureaus and Divisions in which they are employed, but it would be a better administrative policy to have the positions transferred to the Library roll, and it is believed that the change would improve the Library service.

While the Library has been benefited by its removal to its present location in the east wing of the new building, the rooms, having been built for laboratory purposes, are not well adapted for library uses, and, furthermore, it will not be long before more room will be required by the Library. Therefore, in the consideration of plans for the completion of the Department building, it is earnestly recommended that ample and suitable provision be made for the various requirements of the Library and for its future growth.

REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., October 24, 1908.

Sir: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1908.

Respectfully,

A. C. True, *Director.*

Hon. James Wilson,
Secretary of Agriculture.

INTRODUCTION.

As in previous years, the work of the Office of Experiment Stations during the last year has included the supervision of the expenditures of Federal funds by the agricultural experiment stations in the several States; conferences and correspondence with station officers regarding the management, equipment, and work of the stations; the collection and dissemination of information regarding the progress of agricultural education and research throughout the world by means of technical and popular bulletins; the management of the agricultural experiment stations in Alaska, Hawaii, and Porto Rico; special investigations on irrigation and drainage, conducted largely in cooperation with experiment stations, educational institutions, and other agencies in different States and Territories; and the promotion of the interests of agricultural colleges and schools and farmers' institutes throughout the United States.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The work of the Office in its relations with the experiment stations has steadily increased as a result of the added duties involved in the administration of the funds arising from the Adams Act. The plans for investigation under this act have been worked out with unusual care and deliberation. Numerous questions are constantly arising as to the nature of the work actually contemplated in connection with the projects submitted by the different stations, and a large amount of correspondence has been necessary in the settlement of the questions thus raised. An effort has been made to arrive at a clear understanding in advance, in order that the stations might not be embarrassed by incurring expenses on account of lines of work which could not be approved at the end of the year. The result has been quite satisfactory. The stations now have a quite clear idea of the kind of work which, under the Department's interpretation, can be conducted under the Adams Act, and the decision of the Department to hold the fund for a high order of investigation has received general approval.

The Office has compiled a list of the projects of the several stations, and these projects serve as a basis for the inspection of the work and examination of the accounts. A separate set of vouchers for the Adams fund is required, and it is expected that the relation of each expenditure to these projects can be readily explained. The examination of the work and expenditures now made in connection with the annual inspection has greatly increased the time required for the inspection. Many questions arise which require considerable discussion to settle satisfactorily, and on the other hand the station workers take advantage of the opportunity to inform themselves more thoroughly regarding the Department's attitude toward the Adams fund work.

The same amount of attention has been given to the work under the Hatch Act as heretofore, and there has been no change in our attitude in regard to the use of that fund.

With the growth of the business of the stations more money is required to pay for administrative and clerical work, printing, and miscellaneous expenses. The States have in many cases made liberal appropriations for special investigations, but have not always increased the income of the stations for general expenses. It has seemed to this Office that it was the intention of Congress that the Hatch fund should be largely used for definite experimental work, and we are therefore urging the stations to secure State appropriations more largely for general expenses. The Hatch fund is now more generally relieved of expenses for farmers' institutes, compilations, and other objects not directly connected with experimental inquiries, and it is the intention of this Office to insist more strongly on a strict interpretation of the Hatch Act in these regards.

The stations are feeling very keenly the desirability of publishing their more scientific work separately from the practical results. The latter should be put in concise, clear, and readable form for farmers and should be widely distributed. The scientific work should be published in detail in limited editions for the benefit of other investigators. There is a growing sentiment in favor of some general plan for these scientific publications by which they could be issued in proper form and in such manner as to be readily accessible to scientific men the world over. With the accumulation of scientific material under the operation of the Adams Act it is very desirable that definite action on this important matter be secured at an early day.

The Office has continued to follow and record the progress of agricultural experiment stations in foreign countries, and to publish accounts of their organization, resources, and work in the Experiment Station Record and elsewhere, and the steady growth of institutions for agricultural experimentation throughout the world is reflected in the enlarged business of the Office in its relations with the foreign stations. The Office is coming into closer touch with the foreign stations, is getting more regular and complete accounts of their work, and is publishing an increasing amount of information from these sources which is useful to our investigators, teachers, and farmers.

RELATIONS WITH INSTITUTIONS FOR AGRICULTURAL EDUCATION.

The educational work of the Office of Experiment Stations for 1907–8 was continued under the same general arrangement and with the same appropriation as in the preceding year, one section dealing with agricultural colleges and schools and the other with farmers' institutes and other forms of extension work in agriculture.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

The work of the Office relating to agricultural colleges and schools included, as formerly, four general classes: (1) The collection and publication of information regarding the progress of agricultural education at home and abroad; (2) studies of different grades of American and foreign schools in which agriculture is taught; (3) work in cooperation with the Association of American Agricultural Colleges and Experiment Stations and other important associations dealing with educational matters; and (4) the giving of aid to agricultural colleges and schools and to State and local school authorities along lines of agricultural education. This work is in charge of Mr. D. J. Crosby, as specialist in agricultural education.

(1) The department of agricultural education in the Experiment Station Record has contained numerous abstracts and notes and occasional editorials relating to this subject. The preparation of these involved the examination regularly of many educational journals and other publications, both American and foreign. The foreign publications, more than 1,700 in number, were reviewed by Miss M. T. Spethmann, who has also, as formerly, had charge of the preparation of the annual statistics and organization lists of the agricultural colleges and experiment stations. There have also been published a circular on A Secondary Course in Agronomy, a bulletin entitled Simple Exercises Illustrating Some Applications of Chemistry to Agriculture, and a Yearbook article on Training Courses for Teachers of Agriculture. A review of progress in agricultural education in 1907 was also submitted for publication. The list of institutions in the United States offering courses in agriculture has been revised and shows a gratifying increase in the number of such institutions, especially in the normal schools and other secondary schools. In the original list issued in February, 1907, there were 30 normal schools teaching agriculture, as compared with 115 State and county normal schools now, and 105 other secondary schools, as compared with 320 now. The total number of institutions listed has increased from 211 to 533.

(2) Studies of American and foreign schools in which agriculture is taught have been carried on in connection with the editorial and other work of the Office, and the number of cards in the index to these institutions has been increased by 495, making a total of 4,175 such cards. The number of cards of foreign agricultural research institutions is now 1,225. Whenever possible in connection with the annual inspection of agricultural experiment stations and on occasions when members of the staff have been called upon to attend

important meetings, the work of American colleges and schools of agriculture and of normal schools offering courses in agriculture has been studied. During a part of the year the Office had the assistance of a graduate student in the Teachers' College of Columbia University, as collaborator, in making a study of public secondary schools offering courses in agriculture.

(3) The educational work in cooperation with the Association of American Agricultural Colleges and Experiment Stations has been carried on as formerly. The Director of this Office has continued to act as bibliographer of the association and as chairman of the committee of the association on instruction in agriculture, which is now engaged in studying courses in agricultural engineering and in home economics. He accepted for the third time the position of dean of the Graduate School of Agriculture, which held a very successful session during July, 1908, at Cornell University. He has also accepted the chairmanship of a standing committee on horticultural education appointed by the National Council of Horticulture at its meeting in Norfolk in November, 1907, and has attended two meetings of the committee to consider courses in horticulture for elementary and secondary schools.

The specialist in agricultural education has continued to act as secretary of the committee on instruction in agriculture of the Association of American Agricultural Colleges and Experiment Stations and has aided the committee on industrial education in schools for rural communities of the National Education Association to prepare a report on the teaching of agriculture in secondary schools. To this end he visited schools at Waterford, Pa., and Calvert, Md., and prepared detailed memoranda of their work which were incorporated in the report of the committee as submitted at the annual convention of the association in Cleveland, June 29 to July 3, 1908.

(4) The giving of aid to agricultural colleges and schools and to State and local school officers along agricultural lines continues to draw heavily upon the resources of the Office. The number of public elementary and secondary schools in which agriculture is taught is increasing at an astonishingly rapid rate, and every material increase of this kind is followed by greater demands upon this Office for publications, for assistance in outlining courses of study, or for advice concerning some matter of practice or policy. In the matter of helping these schools to find competent teachers of agriculture the Office has met with serious difficulties. There are not enough competent teachers to be had. The Office maintains a card directory of over 1,500 teachers and investigators in agriculture, including a supplementary list of those seeking positions, but the latter are few in number and only a small percentage of these are candidates for public school work. Our directory undergoes a general revision annually, besides being revised in part almost daily. This work is done by Miss M. A. Agnew, who has also been put in charge of recording changes in the organization lists of the colleges and stations and compiling these lists for publication annually.

The demands upon the Office for assistance in outlining and organizing agricultural courses in public and private schools, and for addresses at large conventions, lectures at colleges and universities, and other services requiring the absence of our men from headquarters have been greater than in any preceding year. During nearly the whole of July and August, 1907, and the whole of June, 1908, Mr. H. O. Sampson was engaged in teaching teachers of agriculture at institutes and summer schools, and similar work was assigned to him for July, 1908. He has also spoken at two State meetings of teachers.

The specialist in agricultural education has given a course of five lectures to teachers at the summer school of the University of Texas and will give similar lectures in July, 1908, at Miami University, University of Tennessee, and Massachusetts Agricultural College. He has also given addresses at three department meetings of the National Education Association, at national and State meetings of farmers' institute workers, at the convention of the American Seed Trade Association, at State meetings of teachers, and at several other educational gatherings; and has visited agricultural colleges and schools and State normal schools in most of the Rocky Mountain and Coast States, and helped to organize boys' corn-growing contests in Michigan.

The Director of the Office has taken part in several important educational conferences and spoken at a number of State meetings and other gatherings of educators, and other members of the Office staff have given occasional addresses.

PLANS FOR 1908-9.

Congress, at its last session, increased the appropriation for farmers' institutes and agricultural education from $5,000 to $10,000. This will enable the Office to devote about $2,500 more than previously to its work in connection with agricultural colleges and schools, and with this it is planned to employ an assistant to the specialist in agricultural education and some additional clerical help. The lines of work will be continued practically as in former years, but it is expected that the additional funds will make it possible to increase the effectiveness of our organization. Plans have been made to cooperate with other bureaus of the Department in preparing two new classes of publications for the use of teachers and pupils in public schools: (1) Instructional publications, to include brief monographs telling how to perform certain agricultural operations, such as making and applying Bordeaux mixture, selecting, storing, and testing seed corn, raising Irish potatoes, packing apples for market, etc.; (2) informational publications, to include brief monographs concerning the origin, distribution, and importance of leading agricultural crops. At the same time it is hoped that more rapid progress can be made in preparing courses of study which shall be suggestive for colleges of agriculture, State normal schools, and secondary and elementary public schools. The Forest Service is now cooperating with the Office in preparing a series of exercises in forestry for use in secondary schools.

One thing which needs especially to be done at this time is the preparation of suitable courses for the training of teachers of agriculture. Both the colleges of agriculture and the State normal schools are asking for help in outlining such courses, and it is hoped that opportunity will soon be afforded us to give careful and thorough study to the problems involved in organizing work of this kind.

It will be the policy of the Office steadily to increase its effectiveness as an agency for gathering agricultural information from all the many sources from which it is now issuing, both American and foreign, and for working up this information into form suitable for use in schools of different grades. The Office has better access to such information than any other institution in the United States, and it is our hope that the value of its services as a clearing house for this material will increase as rapidly as additional funds are provided for the purpose of collating the information, putting it in pedagogical form, preparing it for publication, and distributing it among the many agencies engaged in teaching agriculture to the youth of our land.

THE FARMERS' INSTITUTES AND EXTENSION WORK.

The Office has continued its efforts to promote the general interests of farmers' institutes in the United States in cooperation with State directors and local managers of institutes, and has endeavored particularly during the last year to aid the agricultural colleges, experiment stations, and other organizations in perfecting methods for the more general diffusion of agricultural knowledge among the rural population under the various forms of so-called "extension work" which are now claiming a large share of attention from agricultural educators. This work has been as heretofore under the immediate direction of the farmers' institute specialist, Prof. John Hamilton.

During the year the farmers' institute specialist visited and delivered lectures in institute conventions in 8 States—Indiana, Kentucky, Maine, Michigan, New York, Pennsylvania, South Carolina, and Virginia. He also visited MacDonald College, in the Province of Quebec, Canada, and a correspondence school in Pennsylvania, for the purpose of studying their methods of agricultural extension work.

Reports received during the fiscal year from 39 States and Territories in which institutes were held show marked progress in institute activity in all directions—in increased attendance, in the number of institutes, in the sessions of the institutes held, and in the amount of money appropriated for institute work. From the data reported it is estimated that the number of institutes held during the year was about 4,000, with a total attendance of nearly 2,000,000.

Efforts have been continued to organize and develop movable schools of agriculture, which are intended to supplement farmers' institutes by short courses of instruction in special subjects at the agricultural colleges and in different agricultural districts. To aid this movement by showing definitely the character of courses of instruction which might be given on this plan, the Office has arranged with agricultural experts for the preparation of a number of such courses.

It is believed that work along this line should be pressed and that opportunity should be given this Office to aid effectively in the working out of plans for such schools and conducting the experiments necessary to adapt to American conditions this agency for the agricultural education of adults, which has proved so effective in European countries.

In cooperation with the standing committee on extension work of the Association of American Agricultural Colleges and Experiment Stations, the Office has made an extended study of the agencies outside of farmers' institutes which have been or may be utilized in diffusing agricultural knowledge among the rural population at large, and the results have been embodied in reports of the committee and in circulars of the Office. In connection with this work a study has been made of the progress of agricultural education in foreign countries as well as in the United States.

The Office has continued to work in close cooperation with the American Association of Farmers' Institute Workers, the twelfth annual convention of which was held at Washington, D. C., October 23-24, 1907, and was attended by 131 delegates, representing 25 States and Territories, and 4 Provinces of Canada. The proceedings of this convention have been published as a bulletin of the Office.

In view of the growth of interest in farmers' institutes and other forms of extension work in agriculture, it is believed that much of the work of the Office in this field may be profitably devoted to the devising of methods suited to extension conditions and to securing the cooperation of State and local educators in introducing them into their courses of instruction.

PUBLICATIONS OF THE OFFICE.

The publications of the Office during the last year have been of the same general character as in previous years, but decreased somewhat in number and volume owing to the discontinuance of investigations in nutrition and to efforts to restrict publication to the lowest limits consistent with the efficient performance of the functions of the Office. The supervision of the editorial work of the Office, in case of all publications except the Experiment Station Record, is the special business of the Editorial Division of the Office, of which Mr. W. H. Beal is chief. The editorial management of the Record is in direct charge of Dr. E. W. Allen, Assistant Director.

During the fiscal year the Department published 68 documents prepared by this Office, not including revised reprints, separates, etc., aggregating 3,839 pages. These documents included 13 numbers of the Experiment Station Record, 12 technical bulletins, a report of the Alaska experiment stations, 3 bulletins and 2 reports of the Hawaii Experiment Station, a report of the Porto Rico Experiment Station, 2 reports of the Office, and 8 Farmers' Bulletins (including 6 numbers of Experiment Station Work), 5 circulars, 12 monthly lists of experiment station publications, and various miscellaneous documents. Two other numbers of the Experiment Station Record, 1 technical bulletin, 1 annual report of the Office, 1 Farmers' Bulletin, 3 articles for the Yearbook of the Department, and several miscellaneous documents, containing about 800 pages, were prepared and submitted for publication before the close of the fiscal year. Seventeen separates of individual articles contained in larger reports, aggregating 547 pages, were reprinted in editions of varying size to supply requests for the articles.

Several of the earlier technical and Farmers' Bulletins prepared in this Office were exhausted during the year and were reprinted, in several cases with complete revision or more or less important additions and corrections.

The publications of the Office during the year were, as heretofore, of five main classes: (1) Annual reports, including the administrative report of the Director and the larger annual report of the Office. (2) Experiment Station Record, which gives a technical review of the current literature of agricultural investigation throughout the world, and Experiment Station Work, which is published periodically in the Farmers' Bulletin series of the Department and gives a popular summary of some of the more salient practical results of the work of the experiment stations. (3) Publications relating to the food and nutrition of man, consisting of technical and popular bulletins, circulars, etc., reporting or based upon the results of nutrition investigations conducted under the auspices of the Office. (4) Publications relating to irrigation and drainage, which include reports, technical and popular bulletins, circulars, etc., giving the results of the irrigation and drainage investigations of the Office. (5) Educational and other publications, including those relating to agricultural education in general, farmers' institutes, proceedings of the Association of American Agricultural Colleges and Experiment Stations, and of the Association of Farmers' Institute Workers and similar publications, and the card index of experiment station literature, besides miscellaneous documents of various kinds.

ANNUAL REPORTS.

During the year the Office issued as usual two annual reports—one, the administrative report of the Director (of 71 pages), giving a summary of the work of the Office during the year for incorporation in the annual reports of the Department, and the other, the annual report of the Office (of 434 pages), specially authorized by joint resolution of Congress and containing the detailed reports of the results of the annual inspection of the work and expenditures of the State agricultural experiment stations, a summary of the work of the Office, and articles on nutrition, irrigation and drainage, farmers' institutes, agricultural education, and various special lines of investigation at the experiment stations, which are intended to show recent progress in agricultural research and education in the United States.

EXPERIMENT STATION RECORD.

During the year Volume XIX of the Experiment Station Record has been completed. Abstracts of over 4,650 articles have appeared, covering as in previous years the publications of the agricultural experiment stations of the United States and the United States Department of Agriculture, the researches of experiment stations and similar institutions in all parts of the world, and a large number of articles having a direct bearing upon agricultural science and practice as published in book form or in the journals of this country and abroad. The character of the Record as a world review of agricultural experimentation has been maintained, but the limitations of space, to which reference has been made in previous reports, have operated to delay to an increasing degree the publication of material, and to render impossible the presentation of many articles in sufficiently extended form to meet the needs of experiment station workers. In the effort to economize space the condensation of abstracts has been carried to such a point that there is a widespread desire for fuller accounts of the work, especially that published in foreign languages or in journals seldom accessible to station workers in the original.

During the year the increase in the number and importance of articles to be reviewed has been such as to make it impossible, even though restricting the length of the abstracts to the usual extent, to prevent the accumulation of unpublished material in considerable quantity. The scientific publications of the experiment stations and of this Department alone increased 10 per cent in number, and a more systematic organization of the methods of examining the foreign [illegible]ature to be noted brought to light a large number of articles of value from obscure sources. As a result of these increases, at the close of the fiscal year more than 1,700 abstracts of foreign articles were awaiting publication, some of which had been prepared several months before. Under these circumstances the period between the publication of an article and the appearance of the abstract, which in many cases will form the sole available clue of the station or Department worker, is too long to be satisfactory. An extension of space is imperative to avoid not merely the continuance but the inevitable aggravation of these conditions.

The appreciation in which the Record is held is more manifest each year. It has become a great repository of information pertaining to agriculture, which can otherwise be found only by extended examination of the mass of literature published during the last twenty years, and as time goes on the carefully indexed volumes become of still greater value. That this is being realized is shown by a steady demand from libraries and public institutions, as well as from agricultural workers, for the numbers of earlier volumes, and by increased requests for the current issues. Though the free distribution is carefully restricted, the former edition of 6,800 copies has proved insufficient, and an increase to 7,500 copies has been made. A considerable part of this is made necessary by the increase in the station personnel through the addition of investigators under the Adams Act.

EXPERIMENT STATION WORK.

Six numbers of this series were issued at bimonthly intervals during the year, first in large editions in the regular Farmers' Bulletin series of the Department and afterwards in smaller editions (3,500 copies) with consecutive paging, so that they may be bound with index, table of contents, etc., in convenient form for reference.

CARD INDEX.

Copy for 900 cards of the index of experiment station literature was prepared in the Office and submitted for publication during the year. This keeps the index as nearly up to date as has been found practicable. Some of the earlier cards, of which the supply has been nearly exhausted, have been reprinted in order to meet the increasing demand for sets of this index. The number of index cards distributed has reached 29,200. The receipts from sales of the index during the year were $227.17.

INSULAR STATIONS.

The business connected with the insular stations has remained in general charge of Dr. Walter H. Evans as chief of insular stations, and he has necessarily given a larger share of his time to this work.

The policy of conducting investigations that will result in the diversification of agriculture has been continued at all the stations maintained by this Office, and the stations are now becoming recognized as important adjuncts to the permanent development of Alaska, Hawaii, and Porto Rico. Some of the lines of work at the various stations that have been previously reported upon have been completed or supplanted for a time by others that were believed to be of more immediate importance. While the present needs of the people for whom the stations are striving receive as much attention as possible, yet in no instance is the scientific trend of investigations sacrificed for immediate results.

In as undeveloped a country as Alaska, pioneer work must of necessity have an important place for years to come, yet so much advance has been made in the investigations carried on by the stations in that Territory that it is now possible to make specific recommendations regarding a number of agricultural and horticultural problems. In Hawaii and Porto Rico distinct progress is reported in the improvement of the agriculture of those islands, and it is readily shown in the adoption of new methods of cultivation, new crops, etc.

Congress at its last session made an appropriation for the establishment and maintenance of an agricultural experiment station on the island of Guam, and preliminary investigations have been conducted during the past summer to determine the agricultural possibilities and most urgent necessities of that island.

As in the past, the various bureaus of this Department have been generous in cooperating with the insular stations, and in this connection it is desired to make proper acknowledgment to each for its assistance.

The administrative work of the Washington office in connection with these stations has increased very considerably in the last few years. The duties of the accountant of the Office in connection with the financial management of the stations have become a very important part of his work, now occupying fully one-fourth of his time, and with the increased revenue of the stations this work will extend, and, under the present regulations, become more and more important.

During the fiscal year the revenue of each of the stations was $24,000, supplemented by sales and other funds as follows: Alaska, $4,987.84; Hawaii, $750.32; and Porto Rico, $3,546.15. Under the law these miscellaneous funds are available for the maintenance of the stations and have been so expended.

The character and scope of the work carried on at the different stations are briefly summarized below.

ALASKA STATIONS.

A few changes have been made in the personnel of the stations' staffs. Mr. F. E. Rader, who had been superintendent at the Rampart Station for about three years, resigned, and Mr. J. W. Gasser, of the Kansas Agricultural College, was appointed in his stead.

Mr. J. W. Neal, formerly in charge of the Copper Center Station, has been placed in charge of the newly opened station near Fairbanks in the Tanana Valley. Mr. P. H. Ross resigned from the superintendency of the station at Kenai, and no successor has been appointed, as the work of the Kenai Station has been merged with that on Kodiak Island.

The work at the different Alaska stations has not undergone any material change. At Sitka, horticultural investigations have first consideration, and plant breeding is being extensively carried on in an effort to secure better and hardier varieties of fruits, etc. The new hybrids between the native and cultivated strawberries and between the native salmon berry and the cultivated raspberry promise to fruit this year for the first time, and it is hoped that some of them will prove worthy of further experimentation. About 2,000 strawberry hybrid seedlings and 1,000 salmonberry-raspberry crosses are now being grown in the station nurseries. The work with apples, cherries, and plums is being continued, and a few cherries of some of the varieties have ripened. After a number of attempts the station at Sitka has been able to take up experiments with chicken raising, and the work thus far has been quite successful. An incubator was secured and worked with reasonable satisfaction. As soon as possible more extensive chicken houses and pens will be built and several promising breeds will be introduced to extend this experiment.

At the Copper Center and Rampart stations cereal growing receives most attention, and by continual systematic selection early-maturing varieties of oats, barley, and wheat are being sought. At Rampart, in the Yukon Valley, some varieties of these grains have ripened every year since the establishment of the station in 1900, but they have been less successfully grown at the Copper Center Station, where heavy frosts have repeatedly destroyed the crops. In addition to cereals, attention is being given to the cultivation of potatoes and hardy vegetables, as well as to experiments with native grasses and leguminous plants. At the Copper Center Station most of the work in this line is being continued, and some fifty varieties of these plants have been collected and are being grown under cultivation for comparative studies on their adaptability for domestication.

During the fiscal year work was actually begun at the Fairbanks Station, reserved by Executive order March 22, 1906. About 10 acres of land were cleared and planted to potatoes and oats for horse feed and selection purposes and for seed for the next year. Actual experimental work was carried on on only a few small plats, and most of the activity of the station was confined to the clearing of the land and the erection of necessary buildings.

The live-stock breeding work has been consolidated by the removal of animals and equipment from Kenai to Kodiak, which is more accessible. The transfer of the stock was effected in the autumn of 1907. The station has at present on Kodiak Island about 60 head of pure-bred Galloway cattle, and they have proved hardy and well adapted to their surroundings. The reservation of 160 acres near the town site of Kodiak was found too small for the purpose of a stock farm, and 150 acres of land adjoining has been temporarily inclosed and added to the above reservation. Even with this addition, the area has proved too small for the desired purpose, and a tract in the valley at the head of Calsinsky Bay, about 15 miles from

Kodiak, has been selected and will be surveyed with a view to its permanent reservation for station purposes. When this is secured the herd will be divided and the more promising dairy animals will be kept near the village of Kodiak and the rest of the herd removed to Calsinsky Bay. At present the principal energies at this station are devoted to the erection of buildings, fences, etc. Although the live stock and other equipment have been transferred from Kenai, the land has not been abandoned, but is retained, and should transportation facilities be improved in the near future and the region promise to develop, work will be resumed at that point.

HAWAII STATION.

Mr. Jared G. Smith, who had been in charge of the Hawaii Station since its establishment, resigned his commission at the end of the fiscal year to enter into private business, and he was succeeded by Dr. E. V. Wilcox, of this Office. Mr. C. E. Hunn, a graduate of Cornell University, was added to the station staff during the year, and arrangements were made for the addition of a chemist and an assistant entomologist to the staff at the beginning of the current year.

With the increased revenues of the station it has been possible to put the grounds, buildings, and equipment in a much better condition than heretofore. A number of buildings that were erected in the early days of the station and others that were of a temporary character have been removed and from the material a tool house, fertilizer storehouse, laborers' quarters, etc., have been constructed. About 1½ miles of fence was built to inclose all the experimental areas and some additional pasture lands. An addition of about 5,000 feet of iron pipe was made to the water system, and it is now possible to irrigate any portion of the trial grounds. Considerable extension is reported in the orchard plantings, about 200 trees having been added during the year. The banana plantation, which now consists of about forty varieties, has been moved from near the office to a more sheltered location, where conditions for banana growing seem to be more favorable.

The lease on the lands near Hilo, where experiments with cacao and bananas were being carried on, has been terminated, owing to the difficulty of conducting experiments at so great a distance from the station. No work was done during the year on the Hamakua tobacco lands, owing to lack of funds. Half of the land under lease for rice investigations has been surrendered, the portion most conveniently located for further experiments being retained.

During the fiscal year many demands were made on the special agent in charge and other members of the staff to visit localities on the different islands, and practically all important districts of the principal islands were visited in supervising cooperative work or in investigating new problems.

The work of the different departments of the station has been along the general lines described in previous reports. The work in the chemical laboratory was largely in cooperation with other lines of investigation and included analyses of samples of drainage and irrigation water, honey, beeswax, sugar, tannin materials, fertilizers, feeding stuffs, rice, soils, etc.

The principal horticultural work was in connection with shipping experiments with fruits. In these experiments several tons of pineapples, avocados, and papaias were prepared for shipment by methods of packing which previous experiments had shown to be the best. A shipment was made in July and accompanied to San Francisco by the horticulturist, who examined the fruit on its arrival and cabled directions to Hawaii for improvement in methods. In accordance with this advice a second shipment was prepared and forwarded to San Francisco, from which a portion of the fruit was placed in refrigerator cars and shipped east. Pineapples from this shipment arrived in Chicago in excellent marketable condition, and the avocados were in prime condition for immediate consumption. These trials have demonstrated that pineapples can be readily shipped from Hawaii to any point within thirty days' direct communication with Honolulu.

Other horticultural work during the year included experiments in budding and grafting mangoes, transplanting large mango trees, and tests of leguminous plants for green manuring in citrus orchards. The station orchards are in general in a much better condition now than at any time since their establishment.

In the entomological investigations, particular attention was given a study of injurious insects affecting live stock, and in cooperation with Dr. V. A. Nörgaard, Territorial veterinarian, the station entomologist has prepared a report giving a complete survey and detailed account of the sheep maggot fly and the hornfly of cattle. Investigations were continued on the sources and characteristics of Hawaiian honey and a report issued, which has been published as Hawaii Station Bulletin 17. Experiments have been undertaken on the feeding back of low-grade honey for wax production and also on the artificial production of increased quantities of wax through hive manipulation. In company with Dr. E. F. Phillips, of the Bureau of Entomology of this Department, the station entomologist made a complete apicultural survey of the islands. Investigations on the life histories and methods of control of insects affecting rice, citrus fruits, melons, cotton, tobacco, stored products, and pineapples and other fruits are in progress. During the year an outbreak of a species of thrips (*Heliothrips* sp.) was reported on the mango, and investigations showed that it could be controlled by spraying with a strong tobacco decoction to which whale-oil soap was added in the proportion of 1 pound of soap to 10 gallons of the mixture.

The experiments with rice previously reported were continued and have been conducted so as to determine the direct effect of fertilizers under wet and dry-land cultivation and the residual effect of the fertilizers previously applied. Experiments were made in harvesting salt-marsh rice for hay, and these have shown that Hawaii can produce enough rice hay to supply the local market and realize a greater benefit from the cultivation of rice for hay than from the utilization of salt-marsh lands for the production of a low grade of rice for human consumption. The experiments with upland rice grown for hay were not as satisfactory as in the preceding year on account of the exceptionally dry season. Experiments with Chinese and Japanese matting rushes, Sea-Island cotton, peanuts, soy beans, and Leghorn wheat, the latter being especially valuable to supply straw for hat manufacture, are being carried on to determine not only their value as crops, but also their suitability for rotation with rice. Reports on these various lines of work are in course of preparation.

PORTO RICO STATION.

During the fiscal year a number of additions were made to the staff of the Porto Rico Station. Dr. Oscar Loew, for a number of years connected with this Department and later with the College of Agriculture, Tokyo University, Japan, was secured as physiologist of the station, and Mr. P. L. Gile, a graduate of Harvard University, was appointed chemist. Late in the year Mr. E. G. Ritzman, of the Bureau of Animal Industry of this Department, was transferred to Porto Rico as assistant animal husbandman. Doctor Loew, after a few months, found the climate not suited to him and severed his connection with the station.

During the time he was in Porto Rico, Doctor Loew made some important researches upon the fermentation of cacao and coffee, certain alkali conditions of some of the Porto Rican soils, and the fermentation of tobacco as practiced in Porto Rico. During the last year a much-needed chemical laboratory has been installed and furnished with a gas machine, water, and a small working equipment. The study of soils and fertilizers will receive immediate attention.

The horticulturist is continuing the investigations outlined in previous reports, paying especial attention to the improvement of tropical horticultural crops by breeding and selection and to the introduction of others which give promise of adding to the prosperity of the island. The East Indian mango, one of the introductions, seems well adapted to all sections of the island, and it promises to make an addition to the fruit industry.

The entomologist has devoted himself to a study of the insects affecting citrus fruits, pineapples, cotton, etc., and means for their control.

Particular attention has been given to the problems of reforesting some of the barren hills on the station farm, and various species of eucalyptus have given satisfactory results for this purpose. The broad-leaved Honduras mahogany has also grown well and will doubtless prove a valuable addition to the forests. In the low grounds Castilloa rubber, cacao, and cocoanut trees have been successfully planted.

The experiments with introduced coffees are beginning to give good results, and the Java coffees give every indication of retaining their characteristic flavor when grown under Porto Rican conditions. These coffees find a ready market in the United States, and it is believed a good policy to substitute their cultivation for the kinds previously grown, which were not well received by the mainland consumers. A number of planters are setting Java coffee trees in their plantations as rapidly as the trees can be furnished by the station.

The station is continuing to breed pigs and poultry for sale at moderate prices among the planters. The demand for these products has exceeded the supply, and great interest is being taken by the people of Porto Rico in the improvement of their live stock. A dairy is being constructed and a silo has been built. Another silo will be shortly erected and experiments will be made in ensiling the coarse pasture grasses and cane tops, which are now largely wasted.

If these can be preserved in silos for feeding purposes a great benefit will accrue to the live-stock industry.

There is evidence of the introduction of new agricultural industries in Porto Rico, but it seems probable that certain districts will, for some time to come, be devoted largely to a single crop. In these regions the station is carrying on cooperative experiments on a centrally located plantation, the planters paying all the expense of the experiments while the members of the station staff plan and carry out the work. In this way the planters of a neighborhood have an object lesson and the work of the station is brought directly to the farmers. In connection with these cooperative experiments work is always carried on in crop diversification, in order to secure the introduction of other crops than sugar and coffee.

The insular legislature during its session in March appropriated $20,000 for the erection of a building for the exclusive use of the experiment station. This will be constructed of cement and will house the laboratories, offices, and library. This building when complete will supply the urgent needs of the station, and it is also an indication that the people of Porto Rico appreciate the work of the Department of Agriculture in the establishment and maintenance of an experiment station on the island.

GUAM STATION.

Congress during its last session appropriated $5,000 for the establishment and maintenance of an agricultural experiment station on the island of Guam, and some preliminary investigations have been begun. In order that this Office might have definite information regarding the agricultural needs of the island and the conditions under which experimental work must be conducted, Doctor Evans was sent to study the problem of the organization of the station on the ground. The agriculture of the island of Guam is very primitive and is greatly in need of improvement. The principal crop is copra, the dried flesh of the cocoanut. During recent years a pest, one of the mealy bugs, has attacked the cocoanut trees to such an extent as to seriously threaten the industry. Corn and rice were formerly produced in considerable quantity, but rice cultivation has almost ceased, and now about the only vegetables grown are corn, sweet potatoes, yams, and taro, with scarce supplies of beans, onions, peppers, and eggplants. Rice, the principal foodstuff of the island, is imported almost entirely from Japan, although some rice comes from the United States. The live stock of Guam consists of some poor representatives of horses, cattle, carabao, pigs, and chickens. These all appear to be degenerated, doubtless owing to a lack of proper feed and to long-continued inbreeding.

When the station is permanently established the improvement of crops by breeding and selection, the introduction of additional agricultural products, forage-plant production, methods of tillage and soil improvement, live-stock breeding, eradication or control of pests, etc., will receive attention. Work along some of these lines has already been in progress for several years in a large garden attached to the governor's house, and enough has been done to indicate some lines of introduction and experimentation which appear promising and which it is believed will aid in relieving some of the more urgent needs of the 10,000 natives on the island.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

At the beginning of the fiscal year Dr. Elwood Mead, chief of Irrigation and Drainage Investigations, resigned to take charge of a similar work under the government of Victoria, Australia, and the work in irrigation and drainage was divided. Dr. Samuel Fortier, who had been in charge of irrigation work in California, was made chief of Irrigation Investigations, and Mr. C. G. Elliott, formerly chief drainage engineer, was made chief of Drainage Investigations. Such division of the work was rendered especially advisable because of its rapid growth and because the two lines of investigation represented centered to a large extent in widely separated parts of the country.

IRRIGATION INVESTIGATIONS.

With the separation of the work in irrigation and in drainage the Irrigation Investigations were reorganized to a certain extent by placing resident agents in various parts of the arid region, in order to secure a better knowledge of conditions and to make the results more readily available to water users through having in each section a man who will become identified with its interests and known to its people. The branch offices previously established in Cheyenne, Wyo., and Berkeley, Cal., have been maintained, the work in Colorado and Wyoming being directed from the Cheyenne office and the work in California from the Berkeley office. In addition, resident agents who give their entire time to the work have been appointed in Oregon, Utah, Texas, Montana, Kansas, and Arizona, and arrangements have been made whereby men connected with State experiment stations direct the work in connection with their other duties in Idaho, Nebraska, Nevada, New Mexico, and the rice-growing districts of the South. Resident agents will be assigned to the latter States as soon as funds are available and the right kind of men can be secured.

The change in organization occurred at the end of the crop season of 1907. A careful survey of the situation at that time showed special need of work along two general lines—the supplying of useful information to intending settlers and the development of improvements in irrigation practice to conserve our limited water supply, the first applying particularly to the sections just now being brought under irrigation and the second to the sections where irrigation has been practiced longer and the limit of the water supply has been reached or approached. Therefore, it was decided to give special attention to these two lines so far as it could be done without slighting work along other lines already in progress.

SUPPLYING PRACTICAL INFORMATION.

IRRIGATION IN THE VARIOUS STATES.

As a result of the rapid progress which has been made in recent years in the construction of irrigation works, opening up large areas of land for settlement, and the growth of public interest in this subject, the demand for reliable information on present irrigation development and opportunities for settlement in all parts of the arid region has become so great that it was believed that it could only be met by the publication of the essential facts regarding each State and Territory. Wherever satisfactory arrangements could be made these reports have been prepared by the State or Territorial engineers, and in other cases by men of high standing in their respective communities, in order that they may be based on accurate knowledge and have the authority of well-known officials. Standard outlines for these reports were prèpared, and the attempt is made to bring out in them all the essential information regarding irrigation needed by persons contemplating settlement in the arid region—water resources, climate, rainfall, present irrigation development, possibilities of expansion, opportunities for settlement, water laws and their administration, methods of securing rights to water from both streams and canals, etc.

PRACTICAL BULLETINS.

The same influences which created the demand for general information on irrigation in the different States have resulted in a large call for practical information on how to prepare land for irrigation and how to apply water to the different crops grown under irrigation. To help the settler over the critical period of the beginning of a new type of agriculture on new land a series of bulletins describing means of securing a water supply and the methods used in performing all the operations connected with irrigation—clearing land, leveling land, laying out fields and ditches, making irrigation structures, and applying water to crops—is being prepared.

To secure the information necessary for the preparation of these bulletins the practice of the whole arid region has been studied. The regular field force and a number of temporary men employed for this purpose have covered practically the whole irrigated section, studying the methods used by the most successful irrigators, and preparing descriptions of the methods, the conditions to which they apply, and the results secured. These notes will be compiled by our most experienced men and submitted for publication in the form of practical bulletins. A similar report on the irrigation of rice is in preparation.

SCIENTIFIC INVESTIGATION.

Irrigation practice is advanced in two ways—by improvements worked out by farmers in the regular course of their business and by scientific investigation and experiment. In the practical bulletins just referred to the attempt is made to make available the best that has been developed in the former way. The practical work is being supplemented by experiments in which conditions are controlled or recorded, and measurements are made which show accurately the influence of changes in methods on the distribution of moisture in the soil and its retention within the feeding zone of plants.

The water requirements of crops are being studied by means of determinations of soil moisture on a number of farms maintained by the Office in the semiarid region and in cooperation with the experiment stations of most of the arid States.

This, however, is only preliminary to the practical problem of how to secure and maintain these favorable moisture conditions in field practice. In addition to the study of methods of applying and conserving water carried on in connection with these moisture determinations, tank experiments in which conditions are more largely under control and observations are more accurate than in the field have been begun on a large scale in cooperation with several of the western experiment stations. The tanks are arranged in such a way that the water applied can be measured accurately and the tanks can be weighed for determining the losses of the water. Standard outlines for the experiments were prepared and the same experiments are being carried on simultaneously at all the stations as nearly as possible. The experiments consist in applying water by different methods and cultivating the soil to different depths and with different degrees of intensity after irrigation to determine the effectiveness of the different methods of checking losses of water by evaporation.

Experiments on losses by percolation into the subsoil beyond the reach of plant roots have been carried on, and further experiments along this line are planned.

IRRIGATION EXTENSION.

As explained in former reports, the term irrigation extension has been applied to work in determining the value of irrigation in sections where it is not generally practiced, and the methods adapted to those sections. This work is carried on in three separate fields, each with its distinctive problems—the semiarid portions of the Great Plains, the Sacramento and Willamette valleys on the Pacific slope, and the humid East.

In the Great Plains area the farms already established at Cheyenne and Newcastle, Wyo., and at Eads, Colo., have been maintained. At these farms experiments are being conducted to determine the possibilities, methods, and expense of developing small water supplies for the irrigation of limited areas in conjunction with the farming of larger areas without irrigation. Water is being pumped from wells with engines and windmills of different types, and is being diverted from torrential streams during their flood periods, while lands are being cropped without irrigation both with and without summer fallow, for comparison with the irrigated areas.

Both the Sacramento and Willamette valleys have been devoted to wheat growing for half a century, the climate being peculiarly adapted to this type of agriculture. Both, however, are subject to summer drought, which limits agriculture to crops which mature early in the season. The lands have ceased to produce profitable crops of wheat, and the change to other crops necessitates irrigation.

A general study of present irrigation development and the possibilities of its extension in the Sacramento Valley has been made during the past year, and the Office is now cooperating with the University of California in the operation of its farm at Davisville, a large part of which is devoted to irrigation. This land has been laid off to try all the methods of irrigation in use in the arid region for the double purpose of experiment and demonstration.

Work in the Willamette Valley was begun in the spring of 1907. At several points in the valley experiments were carried on in cooperation with local parties, chiefly for the purpose of determining the value of irrigation, as its feasibility was seriously doubted by most of the residents.

At various times in the past studies of irrigation practice in the East have been made, and experiments have been made to determine its feasibility in different types of agriculture. These seem to show that irrigation will prove especially desirable in the growing of truck and hay crops, and that under present conditions it is not profitable to irrigate general farm crops in the humid region. Truck and hay crops are especially liable to injury by drought, one because of the short period of growth, making it susceptible to short dry periods which may occur at critical times, and the other because of its continuous growth, so that it is injured by a rainless period occurring at any season. The work of the past season in the humid region and that planned for the coming year is limited to these two lines.

In cooperation with the Iowa State College, experiments in irrigating meadow land, and also in watering grass crops with sewage water, as is done so successfully in the vicinities of large European cities, are being carried on. The first season of this experiment gives great promise of a satisfactory disposal of sewage and the growth of large quantities of valuable forage at the same time. This system has been in use in European countries for several decades with great profit and without detriment to the health of the communities where the water is used. It has not been adopted in this country, but seems to have great possibilities. In Minnesota preparations have been made for the pumping of water from marsh lands for use on adjoining highlands to determine the possibilities of securing profitable hay crops from both, one now being too wet and the other too dry to grow valuable crops. A general survey of Wisconsin to determine the possibilities of meadow irrigation in the dairy districts of the State was made during the year 1908, looking to future experiments.

In the trucking districts of the South Atlantic States and in the vicinities of the large eastern cities, irrigation is coming to be extensively practiced. In general, the methods used are expensive and not always well adapted to conditions, and plans have been made for a systematic study of the adaptation of methods to local conditions with special reference to lowering the cost. An expert has been employed to give his entire time to this field, and plans have been made and equipment installed for experiments with different methods at the Pender farm of the North Carolina department of agriculture, at Willard, N. C. Other cooperative experiments along the same line will be undertaken.

SUMMARY OF THE WORK OF THE FISCAL YEAR.

The greatest present field for usefulness seems to be the supplying of information for incoming settlers on the lands just being brought under irrigation and those locating in the semiarid region. The preparing of bulletins giving this information has been made the leading feature of our work during the last year, and it will continue to be so for some years.

Looking to the future, economy in the use of water and the reducing of losses as much as possible are the greatest needs of the arid region, since its development in every line will be limited in some degree by the water supply. The securing of the highest economy of water involves an accurate knowledge of the needs of plants and of the methods of putting the water where it is needed and of protecting it against loss. Such knowledge is being secured both by a study of present practice and by experiment.

In the extension of irrigation into new territory we have to demonstrate both the advantages and the methods of irrigating, and this is being done in the semiarid and humid sections of the country.

THE WORK OF THE FISCAL YEAR 1909.

The supplying of practical information to settlers will continue to be of greatest importance for several years. The preparation of publications covering the irrigation of the principal irrigated crops will probably not be completed before the end of this fiscal year, and will extend into the year 1910; while these bulletins must be revised from time to time, making this a permanent feature of our work. They will be the finished product of our work, giving the practical results of all our studies and experiments.

However, these results can not be made of the greatest use by bulletins alone. Personal direction and demonstrations must go with them. This is greatly aided by the placing of permanent representatives in the various States, and this policy will be pushed in 1909. As our agents become known and know their respective territories, they can do a great deal by public and private advice to farmers regarding the methods to be used.

The experiments to work out improvements and the observations to get the benefits of the progress made by farmers must continue as a basis for the other work.

The practice of irrigation will extend rapidly in the semiarid and humid sections of the country for many years, making it advisable to employ experts and carry on experiments in these sections in the same manner as in the arid region. The stations established in the semiarid region at Cheyenne and Newcastle, Wyo., and at Eads, Colo., will be maintained in 1909, and should be continued in 1910 and subsequent years. In the humid region the experiments already begun in Iowa, Minnesota, and North Carolina will be continued, and if suitable arrangements can be made other experiments should be undertaken in cooperation with experiment stations or private parties in other States. An expert will be employed and will have general charge of all this work in the humid region. He will be expected to supervise the experiments and devote much of his time to advising farmers as to methods.

THE FISCAL YEAR 1910.

The work in 1910 should be a continuation of that begun in 1909. The extension of the areas irrigated in all sections of the country will bring about an increased demand for work along all lines. This work of advising farmers can be greatly enlarged to advantage, or it can be continued efficiently on its present scale. The field is practically unlimited, but efficient work can be done on any scale provided for by Congress.

DRAINAGE INVESTIGATIONS.

Since its separation from Irrigation Investigations, October 15, 1907, the work of Drainage Investigations has been rapidly expanded and its working staff increased.

The work of Drainage Investigations is carried on in several ways in order best to meet the varied demands which are made for information, advice, and assistance from all parts of the country and all classes of citizens.

Much information is given out by correspondence alone. In numerous cases an engineer visits the locality needing assistance and after a brief inspection and study of conditions is able to give the desired advice. Technical investigations for the gathering of information of strictly engineering value, such as is now much needed by drainage engineers everywhere in designing large drainage constructions, are carried on in various localities by engineers working singly or with necessary assistance, but the larger part of the drainage work consists in complying with requests from communities desiring assistance and advice in beginning extensive drainage improvements. This requires the collection of a large amount of data on the ground in advance of the preparation of detailed plans. When such work is undertaken, a preliminary examination and report by a supervising engineer is followed by a survey made in cooperation with the local interests by a field party under the direction of the supervising engineer. From the data thus gathered a careful study of the whole situation is made, and maps, profiles, and working plans are prepared which, after approval by a board of engineers, are transmitted to the local authorities for use. Experience shows that the greatest discouragements to drainage movements have been caused by the failure of important undertakings resulting from ill-devised plans for the work.

The preparation of adequate drainage plans requires not only the careful collection of the large amount of requisite field data but also a high degree of technical skill and judgment. It is the plan of this Office to go thus fully into the work only in localities where so little drainage has been done that satisfactory examples of adequate drainage construction are not already available as models. On account of the great impulse that has been given to drainage reclamation in the last few years it is perhaps unnecessary to say that it is entirely beyond the resources of this Office to comply with more than a small portion of the requests that are received for this kind of assistance. In selecting the projects to be taken up, consideration is given to the degree of interest shown by the landowners concerned, their readiness to cooperate in the investigation and to proceed with the execution of the plans which may be developed, the evident ease and quickness with which the drainage improvements may be constructed, and their suitability as examples to other similarly situated communities. The improvement and safeguarding of lands already under cultivation are considered of equal importance with the reclamation of waste lands.

The localities in which the most extensive work was carried on during the fiscal year ended June 30, 1908, and a synopsis of the work carried out are given below:

ARKANSAS.

A survey of a drainage district of 25,000 acres near Wilmot in Ashley County was made during January, February, and March, by a party in charge of F. F. Shafer under the supervision of Arthur E. Morgan. Plans and estimates were prepared for a system of drainage ditches adequate for the reclamation of the district. Near Lonoke an area of about 25,000 acres was surveyed and examined to determine the feasibility of improving the productiveness of the prairie land by an extensive drainage system.

Assistance was given to the authorities of Mississippi County districts Nos. 8 and 9, near Luxora, during April and May, in the way of surveys and advice regarding the design of drainage plans for the district. The work planned in Arkansas will require in its construction the expenditure of perhaps $1,500,000.

COLORADO.

A preliminary examination of the San Luis Valley by C. G. Elliott was followed by extensive field investigations under Arthur E. Morgan to determine the feasibility of reclaiming, by drainage, large areas of land that were once under profitable irrigation, but whose value has been largely destroyed by seepage water and alkali. The report upon these investigations has been transmitted in manuscript form to the local authorities. A preliminary investigation in the Grand River Valley of the valuable fruit lands needing drainage was made by C. F. Brown.

FLORIDA.

A party in charge of Lawrence Brett, under the supervision of J. O. Wright, spent the months from December to April in the Everglades, continuing the investigations carried on during the two preceding years. All natural outlets to the Atlantic Ocean, north of Miami, were examined to determine the feasibility of improving them for drainage channels to relieve the Everglades and Lake Okeechobee. A possible route for a canal was located from the head of the Locahatchee River to the lake, and levels were taken over the line. The lake was entered by going up the Caloosahatchee, and the north and east shores of the lake were carefully examined.

ILLINOIS.

In cooperation with the Illinois Geological Survey, an investigation was begun of the Little Wabash River and its tributaries to determine the damage caused by the overflow of the rich bottom lands in time of flood, and the best means of preventing such injury. This investigation is being continued during the current year. The field work was in charge of L. L. Hidinger, under the supervision of W. J. McEathron.

During April and May, 1908, L. L. Hidinger carried on a study of run-off and discharge conditions in some of the older drained districts of Illinois where the ditches have been in operation for ten years or more. During May, 1908, G. A. Griffin made an investigation of the methods in use along the Illinois River for protecting and draining the valuable bottom lands by means of elaborate and expensive systems of diking and pumping.

KANSAS.

The investigation of flood conditions along the Neosho River, begun during the preceding year, was completed by a party in charge of Lawrence Brett under the supervision of J. O. Wright. A general plan for the prevention of further injury by the overflow of the valuable agricultural bottom lands was devised, using a system of levees extending from Emporia to the Kansas-Oklahoma line. The best plan for doing the work was outlined and its cost estimated. The results of this investigation are embodied in Bulletin 198 of this Office.

LOUISIANA.

A drainage district, including about 15,000 acres in Madison Parish, near Tallulah, was surveyed, and plans were prepared for the improvement of the natural drainage channels. The survey was made by F. F. Shafer, under the supervision of Arthur E. Morgan. The construction of the proposed work is now being undertaken by the landowners interested. A similar district of 50,000 acres, near Mounds in the same parish, was assisted in making the necessary survey and preparing plans by Mr. Morgan.

MINNESOTA.

The laying of nearly 9 miles of tile on the Minnesota Northwest Experiment Farm, at Crookston, was completed in November, 1907, under the supervision of John T. Stewart, of this Office. The installation will test, in an experimental way, the effectiveness of tile in latitudes where the ground freezes to a depth of 6 feet or more in winter, and also the relative merits of cement and clay tile in such a situation. The cost of all the different operations involved in drainage work in this region was carefully determined. A preliminary examination was made of drainage conditions in McLeod County.

MISSISSIPPI.

Three projects in the Yazoo Delta were investigated during the winter months under the supervision of W. J. McEathron. In Tunica County the McKinney Lake district, including 30,000 acres, was surveyed by D. G. Miller, and plans were prepared for its drainage. Over a large area of wet land in Bolivar County the natural channels were examined by S. H. McCrory and recommendations were made for their improvement. Extensive surveys and investigations were made of overflow conditions along the upper reaches of the Coldwater River. A cut-off channel on this river from Askew to Marks was planned, some short cut-offs above Askew were located, and Lake Cormorant Bayou was examined. Surveys and plans were made for drainage improvements in Mississippi, the construction of which will cost approximately $900,000.

NEBRASKA.

Observations were continued on the tile-drainage experiment near Lexington. In the same neighborhood a survey was made for a proposed drainage district. In May, 1908, an extensive survey of the Logan River was begun to determine the best measures for preventing the extensive injuries which now occur to the rich agricultural bottom lands from the overflow of the river. The field work is being done by a party in charge of Lawrence Brett under the supervision of W. J. McEathron.

NORTH CAROLINA.

A survey of the Toisnot Swamp, near Wilson, was made by H. A. Kipp, and plans were prepared for an adequate drainage system. At the request of the North Carolina geological and economic survey, S. H. McCrory, during April and May, made a drainage survey of a portion of the Angola Bay Swamp near Burgaw and prepared plans for a system of ditches to reclaim the area examined.

OREGON.

A system of tile drainage was installed near Albany, Linn County, under the supervision of A. P. Stover, as an experiment to determine the effectiveness of underdrainage in reclaiming the unproductive, worn-out wheat lands in the Willamette Valley.

SOUTH CAROLINA.

In cooperation with the local landowners H. A. Kipp made a survey of Sampit Swamp, near Georgetown, during February and March and prepared plans for the drainage of the swamp. During April and May a survey of the bottom lands subject to injury by overflow along the east side of the Congaree River below Columbia was made by D. G. Miller, and plans were prepared for a system of levees to prevent further injury.

In cooperation with the authorities of Clemson College, this Office assisted in the installation of a comprehensive tile-drainage system on the Coast Lands Experiment Station Farm, near Summerville, by preparing plans for the system and furnishing an engineer to superintend the work. This system will serve as an illustration of the value of tile drainage in the heavy coast lands.

SOUTH DAKOTA.

In June a survey was begun of the overflowed lands lying along the Vermilion River, below Centerville, to determine how best to protect these lands from further injury. The field party is in charge of S. H. McCrory, under the supervision of W. J. McEathron.

UTAH.

Observations were continued upon the experimental drainage of irrigated lands in Boxelder, Cache, Weber, Davis, Salt Lake, Sevier, Millard, Emery, and Washington counties. Surveys were made for additional locations where landowners desired to construct drains.

The unqualified success of the drainage experiments in many places, especially in the northern part of the State, is leading to a large extension of drainage by individual landholders. The work in Utah is in charge of C. F. Brown, and is carried on in cooperation with the State experiment station.

WYOMING.

In continuation of work begun in 1903, further investigations were made to determine the practicability of reclaiming by drainage lands in the Grey Bull Valley which are injured by seepage water and alkali. In cooperation with the State experiment station an experimental tile-drainage system was installed, during May and June, on the university stock farm at Laramie. This system will test the efficacy of tile in reclaiming alkali land so that it will again be valuable for agricultural purposes.

GENERAL TECHNICAL INVESTIGATIONS.

As opportunity has offered, special studies have been made along several lines on which information is much needed by drainage engineers. An investigation was begun to secure data relating to the construction and maintenance and the carrying capacity of drainage ditches in the southern Mississippi Valley States. Similar data were also collected in Illinois and Iowa. Studies of the drainage of peat and turf lands in Indiana, Illinois, Wisconsin, and Minnesota, and of the reclamation of tide lands along the Atlantic coast, from New Jersey to Georgia, were undertaken. Mr. Elliott went to Europe just at the close of the year to study the systems of agricultural drainage in use in England, France, Holland, and Germany.

DISSEMINATION OF INFORMATION.

In addition to the extensive correspondence carried on continually from the Washington office with inquirers for information on the subject of drainage, various members of the scientific staff made addresses and took part in public meetings held to consider this subject. Among the more important of these were: Series of farmers' meetings in North Carolina, Nebraska, Arkansas, Louisiana, and Colorado; the meetings of the National Drainage Association in Baltimore and Washington; the meeting of the American Peat Society in Norfolk, Va.; a farmers' meeting at Georgetown, S. C.; the annual meeting of the Minnesota State Engineers' Society at Minneapolis; and the Good Roads and Drainage Convention at Jackson, Tenn.

WORK PLANNED FOR THE FISCAL YEAR ENDING JUNE 30, 1909.

The projects begun during the last fiscal year, but not completed, will be continued and pushed to a conclusion. New projects will be taken up as rapidly as possible with the staff and appropriation available. The work will be carried on largely in the same States as during the past year. It is planned to take up also work in Delaware, Maryland, Virginia, Georgia, Alabama, and Tennessee, and to increase largely the attention given to irrigated lands needing drainage throughout the arid States. It is also planned to devote a large amount of effort to the technical problems in drainage engineering now most pressing for solution, among which the most important are the maintenance of drainage ditches, the discharge of artificial channels in earth, the drainage coefficient of various kinds of land, and the devices and means for pumping best adapted to handling drainage water.

WORK PROPOSED FOR THE FISCAL YEAR ENDING JUNE 30, 1910.

Investigations begun, but not completed, in 1908–9 will be continued, and the most urgent and important of the projects in new localities will be taken up. Experimental work in the drainage of peat lands, of which there are large areas in various parts of the country, will be inaugurated if possible. The further investigation of the erosion of hillsides under varying conditions, with a view to determining the best method of drainage to prevent such erosion, is another phase of the work which will receive attention.

On account of the present rapid increase in the public interest in this work and the growing demands upon the Office, at least $90,000 will be needed to carry on the work that should be done in 1909–10.

NUTRITION INVESTIGATIONS.

In accordance with the terms of the appropriation made by Congress, the respiration calorimeter, with accessory material, was moved from Middletown, Conn., to Washington, D. C., and stored. The respiration calorimeter and the apparatus used in connection with it are costly and valuable. In addition the Office is in possession of reports of a large number of nutrition investigations, popular summaries, and similar data. The collection of this material has been time consuming and expensive, and much of it is of decided interest and value. On the completion of the new building for the Department of Agriculture adequate and suitable quarters were set aside for the installation of the respiration calorimeter, its reconstruction is now progressing, and it is planned, if funds are provided, to carry on investigations with this apparatus. Among the problems awaiting investigation are the comparative nutritive value and relative importance as sources of energy in the body of lard, beef fat, and other culinary fats, in comparison with butter, cream, olive oil, etc. There should also be further digestion experiments with cheese.

A large amount of information on the following subjects is in hand for publication: The influence of muscular work on metabolism and the human body as a machine; the influence of mental effort on metabolism; dietary studies in rural regions in Vermont, Georgia, and Tennessee; digestibility and nutritive value of flour prepared for the table in other forms than as bread; calcium, magnesium, and phosphorus, and their functions in nutrition; the effects of different methods of grinding and preparing corn meal on palatability and food value; digestibility and nutritive value of fruits, nuts, and their products; the present status of the subject of home economics, particularly courses in nutrition, in American colleges and similar institutions; and a number of other papers on miscellaneous topics connected with nutrition.

Popular bulletins which were prepared for publication include a revision and extension of an earlier Farmers' Bulletin on "Milk and its uses as food," the revision and extension of the Yearbook article on "Nuts and their uses as food," a Farmers' Bulletin which treats of household methods of handling and storing foods and food supplies, and one on household methods of canning and preserving vegetables.

During the year publications on the following subjects appeared: The effect of different methods of cooking upon the thoroughness and ease of digestion of meat, cereal foods and their preparations, food and diet in the United States, and the nutrition investigations of the Office of Experiment Stations and their results.

In addition, the usual summaries have been prepared for publication in the annual reports of the Department and the Office of Experiment Stations, and information has been supplied at the request of Members of Congress, teachers, institute managers, home makers, and others, in so far as practicable, correspondence referred to this Office along these lines being noticeably larger from year to year.

As a part of the regular work of the Office abstracts of the current literature on the general subjects of physiological chemistry and nutrition have been prepared for the Experiment Station Record, as well as popular summaries, particularly of work carried on at the experiment stations, in the series of bulletins entitled "Experiment Station Work."

REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROADS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF PUBLIC ROADS,
Washington, D. C., October 15, 1908.

SIR: I have the honor to submit herewith the report of the Office of Public Roads for the fiscal year ended June 30, 1908, and also an outline of the work planned for the current and ensuing years.

Respectfully,

LOGAN WALLER PAGE, *Director*.

Hon. JAMES WILSON, *Secretary*.

WORK OF THE YEAR.

Never before since the establishment of the Office has there been such widespread and serious interest manifested in road improvement in this country as during the past year. This has taken the form of new legislation in many of the States, large bond issues by many counties, an increased activity on the part of local road officials, and the holding of many conventions under the auspices of organizations of farmers, rural letter carriers, automobilists, chambers of commerce, and, in fact, representatives of every branch of human endeavor in this country. As a consequence, the demands upon this Office were greatly increased, as were also the opportunities for rendering effective aid. It is gratifying to be able to state, therefore, that the Office during the past year accomplished results which exceeded in importance those of any previous year since its establishment.

In the building of object-lesson roads the detailed reports show 31 roads completed and in course of construction, as compared with 20 for the preceding fiscal year. A feature of the year's work was the survey and estimate of cost of a proposed military road between Fort Leavenworth and Fort Riley, Kans., a distance of 120 miles.

More than 200 practical lectures were delivered, as compared with about 150 for the preceding fiscal year.

Experiments with dust preventives were conducted on a larger scale than ever before, and included tests with crude oil, a special oil preparation and rock asphalt at Bowling Green, Ky.; crude tar and various tar preparations at Wayland, Mass.; and calcium chloride in the District of Columbia. Preliminary arrangements for experimental work with various dust preventives were made at Newton, Mass.; with oil and asphalt preparations at Independence, Kans.; with slag and asphalt preparations at Chicago, Ill.; and with slag and tar at Birmingham, Ala., the work at these last four places being actually performed in the current fiscal year.

For the first time since the instruction of engineer students was begun, a thorough course of lectures and study according to an established curriculum was given for the benefit of the students and engineers employed by this Office.

The cooperation of about 2,500 newspapers was gained in a practical campaign of education in the elementary principles of road construction and maintenance.

A preliminary organization for an extensive investigation of systems of road management throughout the world was begun, and cooperation entered into with the Departments of State and Commerce and Labor for securing complete and accurate data on road construction, maintenance, and administration in every country where an American consul is located. The reorganization of a corps of 2,800 public road correspondents in this country was begun.

In the investigation of available road materials in the several States an important arrangement was entered into with the United States Geological Survey, whereby the geologists of the Survey will cooperate with this Office in a joint investigation which will result in great economy in carrying out this project and, at the same time, accomplish much greater results than could be attained by either organization acting separately.

The general advisory work of the Office covered every phase of road work and administration, and careful and detailed records were kept of all work done, involving a complete cost-data system.

The work of the year is fully set forth in the following projects:

OBJECT-LESSON ROADS.

Object-lesson roads are constructed for the purpose of demonstrating practical methods of road building and at the same time to give instruction to local road builders. The Office supplies, at Government expense, one or more engineers for the purpose of making necessary surveys, estimates, and specifications, supervising construction, and giving theoretical instruction. During the past year 5 roads were completed which had been begun in the preceding year, 18 were begun and completed during the year, and 8 remained unfinished on June 30, 1908, and will be reported in the next annual report, making a total of 31. Classed according to the form of construction, these roads may be divided as follows: Ten macadam, 6 sand-clay, 4 gravel, 3 earth, 3 burnt-clay, 1 shell, 2 tar, and 2 oiled roads. For the purpose of comparison the following table is given showing the number of square yards constructed of each type of road during the years 1905, 1906, 1907, and 1908:

Number of square yards of object-lesson roads constructed during 1905, 1906, 1907, and 1908.

Material.	1905.	1906.	1907.	1908.
Macadam	44,944	51,246	76,376	72,587
Gravel	8,804	4,197	11,722	4,608
Shell	5,877	933	--------	14,020
Earth	--------	12,132	27,042	85,967
Sand-clay	19,178	19,443	85,571	42,684
Burnt-clay	400	--------	--------	8,392
Total	79,203	87,951	200,711	223,208

This table shows a decided increase in the mileage of earth roads built, which illustrates the policy of the Office in advocating the form of construction best suited to local conditions and local means. Sand-clay has proved a satisfactory substitute for macadam at much less cost in many sections of the country, and the Office is encouraging a more general use of this method of construction.

MACADAM ROADS.

NORFOLK, VA.—This work consisted in building 3¼ miles of macadam and 3$\frac{8}{10}$ miles of earth road leading from Norfolk, Va., to the site of the Jamestown Exposition, and also in the construction of two pile bridges across Tanners Creek. Excavation was begun December 6, 1906, and the work was completed September 10, 1907. The pile bridges were built by contract. One of them cost $16,831.80, which was paid by the county, and the other cost $11,978.62, one-half of which was paid by the county, since only one-half of the bridge was within the county limits. Owing to the level country through which the road passed, numerous cross-drains, underdrains, and catch basins were required, the total cost of which was $1,799.92. Two sea walls, 110 and 120 feet in length, respectively, were found necessary to protect the road. Their construction required the use of 20 cypress piles, and the total cost of the two walls was $39.83.

The road was built partly with free labor, at $1.50 per day, and partly with convict labor, at a cost to the community of 81⅓ cents per day. The cost of teams was $5 per day. For the foundation course granite was used, a part of which came from a quarry operated by convict labor just south of Richmond, Va., and a part from Port Deposit, Md. The latter was coarse-grained and not well suited for macadam work. The material used for surfacing the road was a good quality of trap rock from Clinton Point, N. Y. The average haul from car to road was 1,385 feet. The width of macadam varied from 16 to 28 feet, the stone being laid in courses as follows: First course, 6 to 8 inches of granite between 1¾ and 3 inches in size; second course, 2 to 3 inches of granite between ⅜ and 1¾ inches in size; third course, 2 inches of trap rock below ⅜ inch in size. The finished thickness of macadam after rolling was from 6 to 8 inches. The amount of crushed stone used was 15,056 tons and cost $19,674.97. The cost of the road was $34,378, which is equivalent to $11,150 per mile of road 20 feet wide, or 95 cents per square yard.

The earth road was constructed by the usual methods. The soil varied from a sandy clay to a sandy loam with some quicksand. On a part of the road where quicksand was present, it was found necessary to use a horse roller instead of the usual 10-ton steam roller. The cost of the earth road was $909 per mile.

PINE BLUFF, ARK.—Grading was begun on the roadway leading south from Pine Bluff to Star City on May 27, 1907, and the road was completed August 1, 1907. This road leads through a level section of country, the soil being a light sandy alluvium. There was 1,700 cubic yards of earth excavated with an average haul of 500 feet. The cost of labor was $1.25 per day. One wooden bridge was constructed at a cost of $85. The stone used for macadam work was a sandstone of good quality. It was shipped 43 miles by rail, and the average haul from car to road was 1½ miles. The total length of road graded was 2,700 feet, of which 2,100 feet was surfaced with stone to a width of 16 feet. The total depth of macadam was 10 inches loose, which was reduced to 7 inches after rolling. Fourteen days were lost on account of rain and delayed shipments of stone. The cost of this road to the community was $3,350.20, which is $8,423 per mile, or 89$\frac{7}{10}$ cents per square yard.

Paintsville, Ky.—The work at this place consisted in improving 5,780 feet of macadam roadway. The survey was begun August 2, 1906, and construction continued to December 17, 1906. Work was resumed June 16, 1907, and the road completed November 16, 1907. Unusual weather conditions were encountered, the frequent and excessive rains causing suspension of work and constant expense for the upkeep of unfinished roadway. Owing to large mud holes in the existing roadbed, considerable time and labor were required to prepare the subgrade properly to receive the macadam. One cross-drain was put in, a 16-inch cast-iron pipe 24 feet long. The stone used was a limestone of very good binding quality but rather too soft for the heavy traffic to which the road is subjected. This stone was shipped by rail a distance of 110 miles and crushed near the work, the average haul from crusher to road being 3,520 feet. A total length of 5,780 feet of road 16 feet wide was surfaced in three courses of 8, 2, and 1 inch, respectively, which compacted to a depth of 8 inches after rolling. The cost of labor was $1.50 per day, with $3 per day for teams. The total cost of the road to the community, including underdrains and catch-basins, was $9,750.74, which is $8,907 per mile, or 95 cents per square yard. In addition to the cost of the road, $221 was spent in fencing.

Montague, Cal.—On September 30, 1907, quarrying was begun preparatory to building 3,020 feet of macadam road from Montague toward Little Shasta, and work was completed on December 4, 1907. During the construction of this road no time was lost on account of rain or other causes. The road was constructed through rolling country with thick, black adobe soil, requiring for drainage purposes three lines of corrugated iron pipe of a total length of 52 feet, varying in size from 12 to 24 inches in diameter. The cost of installing this pipe was $99.90. There was 810 cubic yards of excavation done with rooter plows, a road machine, and a traction engine, the grade varying from 0.4 to 3 per cent. The lava rock used for macadamizing was taken from quarry to crusher, a distance of 75 feet, in cars which were operated over an elevated tramway. The average capacity of the crushing plant was 59.8 cubic yards per day of eight hours, and the average haul from crusher to road was 1¼ miles. A total length of 3,020 feet of road 16 feet wide was graded and surfaced with stone to a depth of 10 inches, which gave a finished thickness of 7 inches after being compacted with a 10-ton roller. With labor at $2.50 per day and teams at $4.50 per day, the cost of this road was $3,509.12, which is equivalent to $6,135 per mile, or 65⅖ cents per square yard.

Sedalia, Mo.—This macadam road was built on the State fair grounds from Sixteenth street toward the administration building, a distance of 2,945 feet. Work commenced on August 1, 1907, and the road was completed on January 3, 1908. The grading was done through a very sticky gumbo soil, requiring excavation to the extent of 3,382 cubic yards, at a cost of $0.331 per cubic yard. The earth was loosened with plows and hauled with wheel scrapers, slips, and wagons. The crushing plant, with an average capacity of 40 cubic yards per eight-hour day, was 200 feet from the limestone quarry, and the cost of hauling from crusher to road, a distance of 3¾ miles, was 77 cents per cubic yard. This excessive haul very materially increased the cost of the road. The total surface macadamized was 11,175 square yards, the finished depth of the 24-foot road after rolling being 4 inches at the sides and 6 inches at the center. There was 3,432 cubic yards of crushed stone used. With labor varying from $1.50 to $2.50, and teams at $3.50 per day, the total cost of road to the community was $6,731.82, which is equivalent to $8,569 per mile, or 60¼ cents per square yard.

CLINTON, WIS.—The construction of a 12-foot macadam road 1,320 feet long from Clinton toward Milwaukee was begun August 19, 1907, and completed October 12, 1907, during which time fourteen days were lost on account of bad weather, and considerable delay was occasioned by inability to obtain teams and labor. The country through which the road passes is slightly rolling, the soil being partly gumbo and partly a sandy loam. The only suitable stone available for this work was taken from a limestone quarry situated 4 miles from the crushing plant, and on account of this long haul the cost of construction was very much increased. A total length of 1,400 feet was graded, of which 1,320 feet was macadamized to a width of 12 feet and a finished depth of 8 inches. In addition, two approaches, each 75 feet by 12 feet, were surfaced in the same way, making a total macadamized surface of 1,960 square yards. In connection with this road a reinforced concrete culvert was constructed, for which 472 pounds of steel and 23 cubic yards of Portland cement concrete were used, the total cost being $167.65. The cost of this road to the community, with labor at $2 to $2.50 and teams at $4.50 to $5 per day, was $2,048, which is equivalent to $7,322 per mile, or $1.04½ per square yard.

PARIS, ARK.—At this place a 12-foot macadam road 1,450 feet long was begun March 24 and completed June 11, 1908. During this time twenty-five days were lost on account of bad weather and one day for lack of teams. The road was built through a rolling country, on a foundation of sandy loam and clay, with a grade of from 0.2 to 0.76 per cent. For drainage purposes 124 feet of vitrified pipe was used, varying from 10 to 18 inches in diameter. End walls for culverts required 20 barrels of cement, 7 cubic yards sand, 24 cubic yards building stone, 5 cubic yards crushed stone, and 383 pounds of steel rods, the cost of installation being $89.54. The surfacing material was a sandstone which was carried from quarry to crusher (a distance of 50 feet) in cars operated on an inclined timber track. The average haul from crusher to road was 2 miles. The stone was spread in three courses to a depth of 9 inches, which after being compacted with a 10-ton roller gave a finished thickness of 6 inches. There was 670 cubic yards of earth excavated at a cost of $0.16 per cubic yard, and 611 cubic yards of crushed stone was used for macadamizing, varying in size from dust to 3 inches. With labor at $1.25 to $1.50 and teams at $3 to $3.25 per day, the cost of this road (excluding culverts) was $925.84, which is at the rate of $3,380 per mile, or 48 cents per square yard.

OPELIKA, ALA.—A section of 950 feet of 12-foot macadam road was begun at this place April 7 and completed May 26, 1908, with six and one-quarter days lost on account of bad weather. The road was built on a foundation of sandy loam and clay, with a grade varying from 0.6 to 2.7 per cent. The surfacing material was a chert, which was placed on the road in three layers with a total depth of 9 inches, giving a finished surface of 6 inches after rolling. The crushing plant was installed 440 feet from the quarry and the average haul from crusher to road was 5,767 feet. There was 184 cubic yards of earth excavated and 320 cubic yards of crushed stone was required for the macadam work. This work was done partly by convict labor at 40 cents per day and partly by free labor at $1 per day, the total cost to the community being $591.55, which is equivalent to $3,286 per mile, or 46⅝ cents per square yard. The building of this road was much delayed and the cost increased from the necessity of driving the crusher with the steam roller.

HUNTINGTON, W. VA.—The work at this place consisted in building about one-half mile of macadam road. As considerable rock excavation was necessary preparatory to the actual construction, work was begun on January 13, 1908, in order that the macadam work might begin as early in the spring as weather conditions would permit. This road was not completed by the close of the fiscal year, and it will be fully described in the annual report for 1909.

CUMBERLAND GAP, TENN.—The preliminary work of grading for a macadam road was begun July 29, 1907. This road, which is about 2 miles long and surfaced to a width of 14 feet, passes through Cumberland Gap in the direction of Middlesboro, Ky., and lies partly in each of three States—Virginia, Kentucky, and Tennessee. In order to establish a satisfactory grade, an unusual amount of rock excavation was found necessary, which, coupled with most unfavorable weather conditions, delayed the completion of the road until after the close of the fiscal year. A full description of the work will appear in the next annual report.

SAND-CLAY ROADS.

EUFAULA, ALA.—At this place a 20-foot sand-clay road 3,000 feet in length was built, leading from Eufaula toward Clayton. Work began December 12, 1907, and the road was completed December 21, 1907, the only delay being two and one-half days lost on account of rain. No excavation was necessary, the natural grade being satisfactory. Two road machines and one drag scraper were furnished by the local authorities. The old road foundation was not disturbed, it being a hard pan with a sandy covering. No material of any kind was hauled, but clay from the side ditches was pulled up by the road machine and puddled with this sand to form the road surface. The total area surfaced, including ditches, was 10,000 square yards, the thickness of sand-clay mixture being about 6 inches, with a crown of 9 inches in the 20-foot section. The total cost of this improvement to the community was $122.58, which is at the rate of $216 per mile, or 1¼ cents per square yard. It is to be hoped that this demonstration will assist the community in developing a practical and economical road system, applicable to all parts of the country.

SEALE, ALA.—Work on this sand-clay road was started January 15, 1908, and completed January 29, 1908, with no delay from any cause. The road, which is 2,330 feet long and surfaced to a width of 12 to 18 feet, was built through a hilly country, the soil being sandy loam and clay. One timber cross-drain 15 inches square, and three V drains, each consisting of three pine poles, were put in. The roadbed was shaped with a grader, and 964 cubic yards of sand was taken from a hill near the road, the average haul being 2,500 feet. This sand was dumped in piles on the clay road, and spread with shovels. The total cost of this road, based on labor at 85 cents and teams at $1.69 per day, was $334.28, which is at the rate of $757 per mile, or 8¼ cents per square yard.

MILLEN, GA.—A total length of 2,465 feet of sand-clay road 15 feet wide was built at this place between February 3 and February 26, 1908, with the loss of four days on account of bad weather. The road was built on a sandy foundation, through a nearly level country, the maximum grade being 3 per cent. There was 682 cubic yards of clay used for surfacing, the average haul from clay pit to road being 2,230 feet. This clay was spread by hand to a depth of 6 inches, and on top of it was placed a 3½-inch layer of sand, giving a finished surface 8 inches thick after mixing. With labor figured at $1.25 per day, the total cost of this road to the community was $268, which is equivalent to $572 per mile, or 6½ cents per square yard.

QUINCY, FLA.—Work was begun on this sand-clay road February 24, 1908, and completed April 13, 1908, with no loss of time on account of bad weather. The road extends 6,500 feet from Quincy over a hilly country toward Bainbridge, Ga. For drainage purposes, 152 feet of vitrified pipe was used, ranging from 4 to 21 inches in diameter, the cost of installation being $79.70. Two gutters 426 feet long, two end walls, and two catch-basins made of brick laid in cement mortar cost $262.82. There was 1,442 cubic yards of clay excavated with an average haul of 1,000 feet. Of this, 1,078 cubic yards was used for fills and 364 cubic yards, together with 862 cubic yards of sand, was used for surfacing, the mixing being done with a disk harrow. The width of the road varied from 16 to 30 feet, giving a total surface of 14,666 square yards. A stretch of 1,000 feet of the old road was an impassable bog, which had to be cleaned out and filled with sand and clay. With labor at $1 and teams at $3 per day, the cost of this improvement (exclusive of brickwork and tile drainage) was $1,009.35, which is at the rate of $820 per mile, or 6$\frac{9}{10}$ cents per square yard.

HINESVILLE, GA.—A sand-clay road was built from Hinesville toward McIntosh, the work beginning March 16, 1908, and ending April 1, 1908, with no delay on account of rain or other causes. The road passes through a sandy and level country with a grade of from 0.5 to 2 per cent. The 622 cubic yards of clay used to mix with the sand to form the road surface was obtained from a pit with an average haul of 1,912 feet. This clay was dumped in piles along the road and spread by hand to a depth of 7 inches, after which a 3-inch layer of sand was spread over the surface, giving a finished depth of 8 inches to the road after compacting. The length of improved road was 2,400 feet, surfaced to a width of 12 feet, and the total cost to the community, based on labor at 75 cents to $1 and teams at $3 per day, was $326.21, which is $718 per mile, or $10\frac{1}{5}$ cents per square yard.

STATESBORO, GA.—The work of building a sand-clay road at this place was started April 29, 1908, and finished May 8, 1908. The improved road, which is 4,550 feet long and surfaced to a width of 20 feet, passes through a rolling country and was built on a sand foundation. A total amount of 1,404 cubic yards of clay and 396 cubic yards of sand was used for the surface mixture, the average haul being 2,000 feet. For a distance of 1,500 feet, a suitable sand-clay mixture was found just below the road surface, and for this section no hauling was necessary. Most of this work was done by convict labor under the supervision of foremen and guards. The total cost to the community was $196.37, which is equivalent to $227 per mile, or $1\frac{9}{10}$ cents per square yard.

GRAVEL ROADS.

HARTINGTON, NEBR.—This work consisted in the construction of a gravel road from Hartington toward St. James. Ditching for the drains was begun on May 27, 1907, and work was completed July 31, 1907. The road passes through a level country of black gumbo soil with some clay. On account of adverse weather conditions, scarcity of labor, and delayed shipments of drain tile the work was delayed forty-two days. It was found necessary, on account of scarcity of gravel and to avoid long hauls over difficult roads, to open several gravel pits during the construction of this road. The average haul from gravel pit to road was 3 miles. For drainage purposes 3,200 feet of 4-inch, 522 feet of 6-inch clay tile, and 48 feet of 12-inch galvanized culvert pipe were used, the cost of installation being $334.82. There was 200 cubic yards of excavation made, with an average haul of 360 feet. The material used for both foundation and surfacing was a clay gravel, the road being built in two layers, with a finished depth of 8 inches after rolling with a 3½-ton horse roller. A total length of 2,000 feet was graded, of which 1,620 feet was prepared for surfacing. The road actually surfaced was 1,390 feet long and 12 feet wide. With labor at $2.50 and teams at $4 per day, the cost of this road was $653, which is $1,968 per mile, or $27\frac{9}{10}$ cents per square yard for the gravel road, and $1,161 per mile, or 9 cents per square yard, for the earth road. This work is being continued by the local authorities, with special reference to drainage and better maintenance. As a result a contract has been let for tiling 1,400 rods of unstable road in Cedar County.

ATHENS, ALA.—The work of constructing a 10-foot gravel road at Athens was begun November 12, 1907, and finished January 18, 1908, during which time nineteen days were lost on account of rain and one day on account of frozen ground. A total length of 3,000 feet was graded to a width of 25 feet in cuts and 18 feet in fills. Of this, 2,600 feet of subgrade was prepared for surfacing and 2,480 feet of road was surfaced in two courses to a depth of 8 inches, giving a finished thickness of 6 inches after rolling. On 1,165 feet of this road a third or finishing course was placed. The foundation course was a 4-inch layer of chert, which, after being rolled, was covered with 4 inches of gravel. In order to establish a satisfactory grade and insure proper drainage it was necessary to excavate 1,420 cubic yards of earth and fill to the extent of 1,185 cubic yards. A total length of 37½ feet of 12-inch tile was used for underdrains and one 4-foot concrete culvert was built at a cost of $82.32. The total cost of this improvement, exclusive of the concrete culvert, was $1,674.32, which is at the rate of $3,564 per mile, or 60¾ cents per square yard. The necessity of hauling the surfacing material for long distances over muddy roads increased the cost of this work very much.

CHERAW, S. C.—This work consisted in the construction of a 15-foot gravel road 5,600 feet long, the road being built by contract according to plans and specifications prepared by this Office. In addition to the road work, three concrete bridges reinforced with steel I beams were constructed. Grading was begun April 29, 1908, to prepare the roadbed for the gravel surface. The work was not completed by July 1, and will therefore be fully described in the annual report for 1909.

TAYLOR, TEX.—On June 7, 1908, work was begun on a gravel road on Main street extending a distance of 2,700 feet. The gravel surface varied from 16 to 22 feet in width and for a distance of 200 feet a 4-foot fill was required in order to establish a satisfactory grade. Most of the gravel was obtained from a pit on the Gabriel River at Circleville, 5 miles north of Taylor, and was hauled mostly with teams, though partly by means of the steam roller and a traction engine. Some gravel for the first course was obtained from the bed of Bull Branch at a distance of 600 feet from the road. Both convict and Mexican labor were used, the latter proving very efficient. This work, which was not completed at the close of the fiscal year, will be fully described in the next annual report.

EARTH ROADS.

LAKE PROVIDENCE, LA.—The work of improving 3,717 feet of earth road within the city limits of Lake Providence was begun August 19, 1907, and finished September 12, 1907, with the loss of one day on account of rain. The improvement consisted in pulling trees, shaping, draining, and ditching, which was done by the usual methods. A total length of 1,000 feet of drainage ditch was cleared and 1,215 feet of ditch opened. The road surface was consolidated with a 3½-ton horse roller. The work was done by the city of Lake Providence and the parish of East Carroll, the former furnishing common labor, teams, and slips, the latter supplying its road outfit, consisting of traction engine, graders, plows, and suction pump. The total cost to the community of the road 3,717 feet long and 36 feet wide was $310.92, which is at the rate of $442 per mile.

WAHPETON, N. DAK.—The work of constructing 1 mile of earth road from Wahpeton toward Lidgerwood was begun August 16, 1907, and completed August 30, 1907, with no loss of time on account of bad weather. This road, which measured 27 feet between ditches, was built through heavy gumbo soil, over a level country, the grade varying from 0.125 to 0.25 per cent. The earth was loosened with 4-horse plows and rooters. Of the 1,572 cubic yards handled only 50 cubic yards was hauled from borrow pit, the remainder being elevated to grade with the road machine. The cost of excavation was 7⅗ cents per cubic yard, shaping and rolling one-fourth cent per square yard. With labor at $2.50 and teams at $4.50 per day, the total cost of this road to the community was $156.60, or at the rate of 1½ cents per square yard.

Calhoun, Ga.—An earth road 2,047 feet long and 30 feet wide was built on the Agricultural Fair Association grounds, the work beginning December 21, 1907, and ending January 21, 1908. The road passed through grass-covered and partly boggy land, making it necessary to dig 888 feet of drainage ditch, at a cost of $32.70, and lay 96 feet of tile drains, at a cost of $27.05. There was 154 cubic yards of earth taken from borrow pits to place on the road, at a cost of 17½ cents per cubic yard, and 52 cubic yards was taken from ditches, at 63 cents per cubic yard. This ditching was all done in wet, soggy soil, which was exceedingly difficult to handle. With labor at $1 to $1.50 and teams at $3 per day, the total cost of this road to the community was $156.50, or 2⅓ cents per square yard, which is equivalent to $404 per mile.

SHELL ROADS.

New Orleans, La.—This work consisted in the construction of a shell drive around the United States Naval Station to replace a driveway which was closed because of improvements about the station. Work began on November 24, 1906, and was completed July 26, 1907. The land adjacent to the road was level, the soil being uniformly alluvial, and the roadbed was prepared by the usual methods. Cross-drains were constructed of tile, a total length of 180 feet being used in six lines of pipe. The cost of installation of these drains was $196.46. A total of 3,071 cubic yards of oyster shells and 1,613 cubic yards of clam shells were used, at a cost of $7,653.11. The average haul to road was 2,000 feet. The foundation course was of oyster shells 7 inches thick, with a 4-inch wearing surface of clam shells. The finished depth of road after rolling with a 10-ton roller was 7 inches. The total length of road graded was 8,927 feet, of which 8,855 feet was surfaced with shells, the average width of surface being 14¼ feet. The cost of labor was $1.52 per day of eight hours, and $5 per day for teams. The total cost of road, including cross drains and ditches, was $14,569.23, which is equivalent to $8,685 per mile, or $1.05 per square yard. The cost was well within the appropriation of $15,000 made by Congress for this work.

EXPERIMENTAL ROADS.

Greenville, Miss.—The construction of a burnt-clay road, according to methods already outlined in previous publications, at this place was begun September 24, 1907, and completed November 4, 1907. The length of the improved section was 1,680 feet with a finished surface 15 feet wide, the average distance between gutters being 40 feet. The road was plowed to a width of 30 feet and the average depth of burnt gumbo was 18 inches. This necessitated the burning of 381 flues, of which 279 were fired with wood and 2 with a combination of wood and coal. The use of coal was a departure from the usual method of burning, but the experiment resulted in marked economy together with increased efficiency. There was no special effort made by the local authorities to keep down the cost of this work, the main object being to ascertain if the gumbo soil could be satisfactorily burned. The price paid for wood was $3 per cord delivered, which was probably 50 per cent in excess of the price for which it could have been purchased by contract. A total of 250¼ cords was used. The fact that this road was built during the cotton season increased the cost of common labor about 25 per cent. An additional item of expense was the unusual depth (18 inches) of gumbo burned, which increased the time and fuel required for burning. The total cost of road was $1,317.26, which is at the rate of $4,140 per mile, or 78⅖ cents per lineal foot. With a less quantity of gumbo burned and under more favorable conditions governing the cost of labor and fuel, it is estimated that this road could be built at the rate of $2,200 per mile.

INDIANOLA, MISS.—The building of 444 feet of burnt-clay road 12 feet wide, in a northerly direction from Indianola, was begun September 12, 1907, and completed October 3, 1907. This was a particularly difficult piece of construction, from the fact that the old road which was to be improved was a single track on an embankment only 12 to 13 feet wide. It had been thrown up 4½ to 5 feet high and corduroyed at each addition to the embankment, thus forming one mass of wet wood and rotten material mixed with the buckshot clay. It was therefore necessary to build the cross flues by hand, and one at a time, thus materially increasing the cost. The depth of burnt clay averaged 12 inches loose and about 9 inches after being consolidated with a 3½-ton horse roller. No time was lost on account of rain or other causes, but owing to the adverse conditions above mentioned, together with the short length of road built and to very inefficient labor, the cost of this road was at the rate of $3,756 per mile, or 53⅓ cents per square yard.

TALLULAH, LA.—On April 30, 1908, work was begun on a burnt-clay road at this place on the Willow Bayou road west of Tallulah. Owing to unfavorable weather conditions this road had not been completed by July 1, and a complete account of the work will appear in the next annual report.

EMINENCE, KY.—This work consisted in the construction of a 12-foot limestone macadam road with oiled surface, 4,070 feet long, from Eminence toward Shelbyville. The road was built on a clay foundation with a maximum grade of 5 per cent. A crushing plant with an average capacity of 80 cubic yards per ten-hour day was installed at a distance of 75 feet from the quarry, the average haul from crusher to road being 2 miles. For drainage purposes a considerable amount of iron pipe and drain-tile was required, together with concrete work for end walls. As the road was not completed by the close of the fiscal year, the work will be fully reviewed in the next annual report.

STOCKTON, CAL.—This work consists in building 10,700 feet of oiled macadam road. Excavation began May 18, 1908, and on June 30, 9,100 feet of the foundation course had been laid. The surfacing material was a hard andesite, obtained from a quarry at Dredge, the contract price being $1 per ton f. o. b. Stockton. The work will be fully described in the next annual report.

BIRMINGHAM, ALA.—The work of building a tarred slag macadam boulevard about 1 mile in length and 30 feet wide began June 13, 1908. Up to the close of the fiscal year work has been confined to grading, no macadam work having been done. The construction of this road will be fully reviewed in the next annual report.

WAYLAND, MASS.—This Office, in connection with the highway commission of Massachusetts, treated portions of the main thoroughfare leading from New York to Boston with crude tar, tarred preparations and oil emulsions. Fifteen different experiments were made, four with water-gas tar alone, three with coal tar, three with mixtures of water-gas tar and coal tar, three with special tar preparations, and two with oil emulsions. The total area covered was 11,118 square yards, at a cost for labor and materials of $913.40. These experiments have been fully reported in Circular 89 of this Office.

INSTRUCTION IN HIGHWAY ENGINEERING.

Five engineer students were appointed for service during the last fiscal year, and of these three are now junior assistant engineers in this Office and two have taken up college work as instructors in highway engineering.

On January 20, 1908, a definite course of theoretical and practical instruction for the engineer students in Washington began, covering a period of eight weeks. The time was divided between lectures and laboratory work as follows:

Monday.—Themes and problems in road construction, history and development of road building, testing laboratory.

Tuesday.—Testing laboratory, petrography and mineralogy, testing laboratory, road legislation and administration.

Wednesday.—Field work.

Thursday.—Dust preventives, plotting, field notes, estimates, field work, and problems.

Friday.—Petrography and mineralogy, road legislation and administration, clays, asphalts, bitumens and cements, laboratory work.

Saturday.—Library, general geology, quarrying, and selection of road materials, testing laboratory.

The plan worked very well and did not in any way interfere with the regular projects of the Office, for the reason that the course was so timed as to be in operation during a period when field work was very much restricted. In addition to the students, those engineers who found it convenient to do so took advantage of the opportunity to receive this instruction. The students were also required to prepare a thesis on some phase of road construction, maintenance, or administration and to enter into discussions on practical topics. Courses of reading were prescribed, embracing the best works on the history of road building, road legislation, administration, economics, construction and maintenance, dust preventives, clays, asphalts, bitumens, cements, and certain other subjects of a miscellaneous character.

The cooperative lecture work with colleges has not yet assumed satisfactory proportions, as the personnel of the Office has been too small to permit of additional work being taken up. Several lectures were delivered at the Maryland Agricultural College and the Washington State College during the year. However, this phase of the work will receive attention during the current fiscal year, as explained in another part of the report.

TESTING ROAD MATERIALS.

The routine testing of road materials comprises microscopic and chemical analyses to determine the mineral composition of the specimens and physical tests to determine their hardness, toughness, cementing value, resistance to wear, water absorption, and specific gravity. During the year 700 samples of material were tested, as compared with 405 for the preceding year. The extent to which the testing laboratory is utilized may be inferred from the statement that samples of material were sent from 42 States and from Italy, the West Indies, and Canada. Each year the Office is working in closer relation with the State highway departments and geological surveys.

As usual, the limestones constituted a large percentage of the materials tested, 186 samples of this rock having been received, as compared with 52 of granite and 59 of trap rock. In addition to ordinary road materials, samples of brick were tested under impact and compression, and tests were also made of twisted steel rods for reinforced concrete work, and of several samples of clay drain-tile. Tests for the Department building committee were made in connection with new construction work.

INVESTIGATION OF DUST PREVENTIVES AND ROAD PRESERVATIVES.

From a review of published experiments with dust preventives and road preservatives, as well as from actual inspection of work of this kind, the fact has been made evident to the Office that a large proportion of the failures which have resulted has been due to improper selection of material and to the ignorance of experimenters with respect to the physical and chemical properties of the various substances employed as binders. This lack of knowledge has resulted in the expenditure of thousands of dollars annually upon experiments which have not only proved costly mistakes, but have served to confuse road builders as to the cause of failure. The need for specific information along these lines has become so manifest that the Office has, during the past year, given considerable attention to the matter and has carried on investigations both in the field and in the laboratory with the special object in view of correlating the physical and chemical properties of dust preventives and road preservatives with the practical results obtained from their use.

Field experiments with various tars, oils, asphaltic compounds, emulsions, and salt solutions have been conducted in the States of Massachusetts and Kentucky and in the District of Columbia, and progress reports of these and similar experiments conducted in the preceding year have been published. Descriptions of field tests are included in the chapter of this report on experimental roads. Laboratory methods of examination and analysis have been devised to enable the experimenter to determine the probable value on the road of the material he desires to use.

INVESTIGATION OF SLAG FOR ROAD BUILDING.

It has been estimated that some 20,000,000 tons of slag are turned out annually from the various blast furnaces of the country. If this by-product possessed the necessary physical properties, it might be used for road construction, but, except in a few cases, blast-furnace slag does not possess sufficient binding power for this purpose, and as it is generally of a friable nature, it powders under traffic to a loose dust. Investigations carried on in the laboratory have shown that by the admixture of a certain amount of lime or limestone its binding power can be greatly increased. As there are many parts of the country where slag and limestone can both be obtained, experiments are being carried on to test this point in practical road construction. It is believed that this discovery will render the use of slag in road building possible and enable road surfaces to be made which will have a better bond than could have been obtained with either material alone. In addition to this, tests are being made to determine the value of slag as a road material in conjunction with bituminous binders such as tar and asphaltic oil.

LECTURES, ADDRESSES, AND PAPERS.

No better indication of the widespread interest in road improvement could be had than the constantly increasing demand upon this Office for lecturers to attend meetings in various sections of the country called for the purpose of considering the betterment of the public roads. That this interest is not confined to any class of people or any one section of the country is shown by the following brief summary of the year's work under this project:

Alabama.—Demopolis, July 2, 1907: Lecture on civic improvement. Myrtlewood, July 3, 1907: Lecture on road improvement. Sweetwater, July 4, 1907: Lecture on general road improvement best adapted to that section. Lectures on road improvement with special reference to sand-clay roads were given at Columbia, August 19; Dothan, August 20; Elba, August 21; Geneva, August 22; Ozark, August 23; Abbeville, August 24; Clayton, August 26; Eufaula, August 27; and Midway, August 28—all in 1907. Union Springs, August 29, 1907: Lecture on road improvement, sand-clay and gravel roads in particular. Seale, August 30, 1907, and Opelika, August 31, 1907: Lectures on road improvement, sand-clay and earth roads in particular.

California.—Stockton, June 1, 1908: Lecture on road conditions in southern California and especially Los Angeles County, before California Good Roads Association. Santa Cruz, June 6, 1908: Address before California Promotion Committee.

Delaware.—Lectures on need of reorganization of local system of administration before farmers' institutes at Bridgeville, January 28, 1908; Milford, January 29; and Smyrna, January 30.

Georgia.—Lectures on sand-clay construction at the following places: Oliver, September 24; Millen, September 25; Waynesboro, September 26; Swainsboro, September 27; Vidalia and Lyons, September 28; Statesboro, September 30, and Glennville, October 1—all in 1907. Darien, October 2, 1907: Lecture on sand-clay and shell road building. Ludowici, October 3, 1907, and Savannah, October 4, 1907: Lectures on sand-clay road building. Gainesville, October 28, 1907: Lecture on macadam and earth roads. Lectures on earth and sand-clay roads at Jefferson, October 29; Lawrenceville, October 30; Homer, October 31; Toccoa, November 1; Clarksville, November 2, and Clayton, November 4—all in 1907. Lectures on construction and maintenance of earth roads at Cleveland, November 6, 1907; Dahlonega, November 7, 1907; and Dawsonville, November 8, 1907. Cumming, November 11, 1907: Lecture on construction of earth roads. Alpharetta, November 12, 1907: Lecture on construction of earth and sand-clay roads. Canton, November 13, 1907: Lecture on construction of earth and gravel roads. Jasper, November 14, 1907: Lecture on construction of earth and macadam roads. Lectures on construction and maintenance of earth roads at Ellijay, November 15; Blue Ridge, November 16; Blairsville, November 18; Young Harris, November 18; and Hiawassee, November 19—all in 1907. Lectures on improvement and maintenance of public roads before farmers' institutes at Georgetown, November 11; Cuthbert, November 12; Fort Gaines, November 13; Dawson, November 14; Albany, November 15; Sylvester, November 16; Newton, November 18; Camilla, November 19; Blakely, November 20; Moultrie, November 21; Tifton, November 22; Ashburn, November 23; Nashville, November 25; Cairo, November 27; Bainbridge, November 28; Colquitt, November 29; and Edison, November 30—all in 1907.

ILLINOIS.—Chicago, October 15, 1907: Address on road improvement before National Corn Exposition. Champaign, January 28, 1908: Lecture on road improvement to students and delegates to Corn Growers' Convention. Peoria, February 12, 1908, and also Warren and Galena, February 24–25, 1908: Lectures on road improvement under the auspices of a farmers' institute.

INDIANA.—Cass County, August 5–16, 1907: Eleven lectures on road improvement before popular assemblages. Indianapolis, September 24, 1907: Address on modern road building before State association of county commissioners of Indiana.

IOWA.—Council Bluffs, September 3, 1907: Lecture on the progress of the good-road and State-aid movement, under auspices of Iowa State Highway Commission. Rippey, October 9, 1907: Address on subject of good roads, under auspices of a farmers' convention. Estherville, March 27, 1908: Address to road officials on maintenance and construction of earth roads, under auspices of Emmet Good Roads Association.

KANSAS.—Manhattan, January 1, 1908: Lecture on benefits of improved roads, under auspices of Kansas State Good Roads Association.

KENTUCKY.—Newport, October 21, 1907: Lecture at county good roads meeting. Louisville, November 21, 1907: Address urging legislation to secure State aid, under auspices of Kentucky State Development Association. Frankfort, February 19, 1908: Illustrated lecture on road administration and construction before a farmers' institute.

MARYLAND.—College Park, March 19 and 26, 1908: Lectures on road construction and maintenance. College Park, April 2, 1908: Illustrated lecture on road improvement. Dorsey Station, April 4, 1908: Lecture with subject "Necessity for progressive policy in road improvement."

MASSACHUSETTS.—Springfield, September 24, 1907: Address under auspices of the Springfield Automobile Club.

MINNESOTA.—Rochester, November 23, 1907: Lecture to popular assemblage.

MISSISSIPPI.—Iuka, September 2, 1907, and Corinth, September 3, 1907: Lectures on earth and gravel roads. Booneville, September 4, 1907: Lecture on earth, sand-clay, and gravel roads. Lectures on earth and sand-clay roads at Guntown, September 5; Tupelo, September 6; Fulton, September 7; Amory, September 9, and Aberdeen. September 10—all in 1907. Caledonia, September 11, 1907: Lecture on earth, sand-clay, and gravel roads. Columbia, September 12, 1907: Lecture on earth and gravel roads. Starkville, September 13, 1907, and Macon, September 14, 1907: Lectures on earth and sand-clay roads. Lexington, September 16, 1907: Lecture on sand-clay, burnt-clay and earth roads. West Point, March 26, 1908: Lecture on road improvement.

NEW JERSEY.—Atlantic City, October 2, 1907: Address on public roads before Public Health Association.

NEW YORK.—New York, December 17, 1907: Address on rural highways before the New York Farmers' Association. New York, February 7, 1908: Lecture on the preservation of steel before Brooklyn Engineers' Club. New York, March 5, 1908: Lecture on extraction of potash from feldspathic rocks before New York section of American Electro-Chemical Society.

NORTH CAROLINA.—Elizabeth City, August 5, 1907: Lecture on earth and sand-clay roads to farmers. Hertford, August 6, 1907: Lecture to farmers on public-road improvement and methods of treating tide-level roads, sandy, and clay roads. Edenton, August 6, 1907: Lecture on road improvement. Plymouth, August 7, 1907: Lecture to farmers' institute. Lectures on good roads before popular assemblages, at Washington, August 7–8, 1907; Greenville, August 9, 1907, and Williamston, August 10, 1907. Gatesville, August 12, 1907: Lecture on good roads before a farmers' institute. Lectures on road construction and benefits resulting from good roads, to popular assemblages at Columbus, October 7, 1907; Hendersonville, October 8, 1907; Brevard, October 9, 1907. Lectures on road improvement before popular assemblages, at Asheville, October 10; Marion, October 11; Rutherfordton, October 12; Waynesville, October 14; Webster, October 15; Franklin, October 16; Bryson City, October 17; Murphy, October 18; Hayesville, October 19; Robbinsville, October 21, and Andrews, October 21—all in 1907. Lectures on road administration and sand-clay roads, under the auspices of a farmers' institute at Richland, January 14, 1908; Maysville, January 15, 1908; and Bayboro, January 16, 1908. Lectures on earth and sand-clay roads, under auspices of a farmers' institute, at Newbern, January 17, 1908; Williamston, January 18, 1908; Plymouth, January 20, 1908; and Creswell, January 21, 1908. Columbia, January 22, 1908: Lecture on sand-clay roads, under auspices of a farmers' institute. Edenton, January 24, 1908: Lecture on earth and sand-clay roads, under auspices of a farmers' institute. Hertford, January 25, 1908: Lecture on road administration, sand-clay and earth roads, under auspices of a farmers' institute. Shiloh, January 27, 1908: Lecture on earth and sand-clay roads, under auspices of a farmers' institute. Moyock, January 28, 1908: Lecture on earth, gravel, and sand-clay roads, under auspices of a farmers' institute. Elizabeth City, January 29, 1908: Lecture on earth and sand-clay roads, under auspices of a farmers' institute.

OKLAHOMA.—Mangum, May 4, 1908: Lecture on road improvement and maintenance.

PENNSYLVANIA.—Philadelphia, November 21, 1907: Lecture on corrosion of iron before section meeting of the Franklin Institute.

SOUTH DAKOTA.—Madison, September 2–5, 1907: Lectures on road improvement before Rural Letter Carriers' Association of South Dakota.

TENNESSEE.—Lectures on road improvement before popular assemblages at Waynesboro, July 20; Hohenwald, July 22; Centerville, July 23; Dickson, July 24; Waverly, July 25; Erin, July 26; Franklin, July 27; Pulaski, July 29; Columbia, July 30, and Lawrenceburg, July 31—all in 1907. Knoxville, December 11, 1907: Address on the work of the Office of Public Roads, under the auspices of East Tennessee Good Roads Association. Jackson, March 11, 1907: Lecture on road improvement before a good roads and drainage convention. Bristol and Blountsville, May 23–26, 1908: Lectures on road improvement. Nashville, July 4, 1907: Lecture on construction and maintenance of the public roads and the relation of the letter carrier to them, under auspices of Letter Carriers' Association of Tennessee.

TEXAS.—Granger, June 17, 1908: Lectures on modern road improvement and the issue of local bonds, under auspices of a road organization of Taylor, Tex.

VIRGINIA.—Amherst, December 16, 1907: Lecture on improvement of earth and stone roads before popular assemblages.

WEST VIRGINIA.—Morgantown, February 3–6, 1908: Lectures on the development of road building, highway economics, construction and maintenance of earth, gravel, burnt-clay, sand-clay, and macadam roads, and an illustrated address before a class at the West Virginia University.

WISCONSIN.—Milwaukee, September 12, 1907: Address on work of the Office of Public Roads, under the auspices of the State Good Roads Convention.

SPECIAL INSPECTION AND ADVICE.

This project covers the general advisory work of the Office. Engineers are assigned to give advice and instruction on every phase of road work. In fact, this project covers practically all of the assignments which may not properly be considered part of any established project. The following summary of assignments of this character shows that advice was given on a variety of subjects, including construction, maintenance, preparation of specifications, experiments with tar, the organization of a commission for road work, and the enactment of road laws.

ALABAMA.—Troy, July 11–12, 1907: Inspection of sand-clay roads and advice regarding same. Montgomery, July 13–17, 1907: Conference with the legislative committee regarding a State road law. Tuscaloosa, July 17–22, 1907: Inspection of local conditions and conference with road authorities with regard to building a mile of object-lesson road. Livingston, July 23, 1907: Inspection of roads and conference with local authorities with the object of building a mile of object-lesson road. Eutaw, July 24, 1907: Inspection of local conditions and advice regarding methods of improvement. Greensboro, July 24, 1907: Inspection and advice as to the best method of treatment of prairie land in southern section of Hale County. Cullman, February 8–9, 1908: Inspection and advice regarding kind of road to be built. Birmingham, March 21–24, 1908: Inspection and advice in regard to building, repairing, and resurfacing county roads, also survey of road. Tuscumbia, June 29–30, 1908: Demonstration of proper methods of repairing.

GEORGIA.—Oglethorpe, May 11–12, 1908: Inspection and advice as to best method of taking care of road. Vienna, May 12–13, 1908: Advice to county road authorities. Americus, May 13–14, 1908: Inspection of roads. Perry, May 15–16, 1908: Inspection of roads and advice regarding same. Lumpkin, May 18–20, 1908: Inspection of roads and advice for their care. Hawkinsville, May 20–22, 1908: Advice in regard to roads.

KANSAS.—Inspection of general conditions in sand-hill region of southwest Kansas, May 18–31, 1908.

KENTUCKY.—Paducah, May 11, 1908: Advice in experiment with tar.

LOUISIANA.—Tallulah, March 30–31, 1908: Inspection of conditions prior to building object-lesson road.

MISSISSIPPI.—Vicksburg, March 29, 1908: Advice regarding inauguration of commission for permanent road improvement

NEBRASKA.—Inspection of local conditions and advice regarding the best method of improving the public roads at Plattsmouth, June 12, 1908; Lincoln, June 17–18, 1908; and Pawnee City, June 19–22, 1908.

NORTH CAROLINA.—Clinton, July 29–August 3, 1907: Advice on the construction of a sand-clay road in Sampson County near Clinton. Lynn, August 15–20, 1907: Inspection of road leading from Tryon to Lynn, and examination of stone of the adjacent section to determine its value as a material for macadam road building; also inspection of gravel deposits in the vicinity. Spray, September 5–6, 1907: Inspection of work on a macadam road being built from Spray to Leaksville. North Wilkesboro, October 19–21, 1907: Inspection of turnpike from North Wilkesboro to Jefferson and report to State geologist. Shelby, March 27–31, 1908: Inspection and advice regarding location of proposed object-lesson road. Windsor, April 1–2, 1908: Inspection and report as to feasibility of building object-lesson road. Hillsboro, April 3–May 9, 1908: Survey for road and estimate of cost. Southport, June 2–3, 1908: Inspection of local conditions and advice as to kind of roads to build. Greenville, June 4, 1908: Inspection of condition of streets and advice as to method of improving them.

OHIO.—Brecksville, February 3–4, 1908: Inspection of steel-track road. Elyria, March 4, 7, and 11, 1908: Advice in determining method of construction and assistance in preparing specifications for contractors.

PENNSYLVANIA.—West Grove, May 26, 1908: Inspection and advice regarding proposed object-lesson road. West Chester, June 17–18, 1908: Inspection of "Old Lancaster Pike" and estimate of cost of resurfacing 1 mile.

SOUTH CAROLINA.—Cheraw, February 23–24, 1908: Preliminary survey and advice in regard to proposed object-lesson road. March 4–5, 1908: Further survey for same road.

TENNESSEE.—Clarksville, May 9, 1908: Advice regarding road being constructed between Clarksville and Guthrie. Clinton, December 12, 1907: Advice regarding macadam roads.

TEXAS.—Crockett, April 20–22, 1908: Inspection of road to be improved by sand-clay method. Hillsboro, April 23–25, 1908: Inspection for proposed gravel road. Nacogdoches, April 26–May 1, 1908: Advice in regard to proposed object-lesson road.

VIRGINIA.—Jonesville, March 5–9, 12–14, 1908: Inspection for proposed object-lesson road. Emporia, May 23, 1908: Inspection for proposed road.

INVESTIGATION OF ROAD MATERIALS IN THE SEVERAL STATES.

In the last annual report reference was made to a proposed investigation of road materials in the several States with the cooperation of State geologists and State highway commissioners. Since the last report was issued, a cooperative arrangement has been entered into with the U. S. Geological Survey, in which the geologists of the Survey are instructed to collect specimens of road materials, which are tested in the laboratory of this Office to determine their physical and chemical properties. The reports of these investigations are then prepared in this Office. At the close of the fiscal year a bulletin (No. 33) on the road materials of Maine had been completed and was in press, and an investigation of the road materials of Minnesota, in cooperation with the State highway commission, was practically completed, and the results are now being prepared for publication.

MODEL SYSTEMS OF ROAD CONSTRUCTION, MAINTENANCE, AND ADMINISTRATION.

This project, referred to in the last annual report, provides for the assignment of engineers to make complete investigations of roads, available materials, methods of construction, maintenance, and administration in the various counties to which they may be assigned, and to prepare complete reports giving all data of value in connection with the road systems under investigation, with recommendations and detailed plans and estimates for the future road work of the county covering a period of several years.

During the past fiscal year Morgan County, Ala., and San Joaquin County, Cal., have received assistance under this project, and the report of the engineer assigned to San Joaquin County is now at hand and contains data on the classification of roads, system of administration, revenues, methods of construction, road materials, and reports of inspection of various quarries and crushing plants, filed as exhibits with the report.

SPECIAL INVESTIGATIONS.

THE CORROSION OF IRON.

In my last annual report I called particular attention to the investigation of the corrosion of iron which has been conducted by Dr. A. S. Cushman, Assistant Director of this Office. The results of this work have already proved of great benefit to road builders. Several of the rolling mills which roll steel for the manufacture of steel culverts have modified their methods of manufacture as a result of these investigations. It is now possible to obtain culverts made of metal which is 99.96 per cent pure iron. There is no doubt that these pure-metal culverts will be found to be as highly resistant to corrosion as it is possible to make them. This is a decided step in advance and shows the practical bearing and application of this sort of scientific investigation which has been carried on for several years past.

The rapidity with which steel wire fencing suffers from corrosion has imposed a great burden on the farmers of the country; and, while this may be considered as only indirectly a road problem, its great importance demands that every effort should be made to bring about an improvement in present conditions. During the course of the year the offer of one of the largest and most prominent wire-manufacturing companies to cooperate with the Office in carrying on a thorough service test was accepted, and arrangements have been completed for hanging on the grounds of the Carnegie Technical Schools at Pittsburg, Pa., about thirty panels of steel wire fence. These panels differ in regard to the chemical constitution of the metal and in mode of manufacture. It is believed that the information gained will, in a few years, enable manufacturers to prepare wire of the highest practicable degree of resistance to corrosion. In addition to these tests, special attention has been paid to processes for coating steel with zinc, lead, or paint films in order to discover a better and more lasting method of preserving the surface. Certain new ideas and discoveries made by Doctor Cushman in the course of his investigations are being tested on a large scale in cooperation with two of the largest and most representative technical associations in the country. The Paint Manufacturers' Association of the United States, working in conjunction with the American Society for Testing Materials, is erecting on the Atlantic seashore a fence consisting of a great number of steel plates, which will be protected from corrosion by mixtures of compounds which have been worked out in the course of these researches. If this test is successful, the information gained will be given out freely for the benefit of the people, and the problem of the protection of steel will be in a great measure solved. The results of this investigation promise to be of the highest value to the farmer as well as to the general commercial development of the country.

THE DECOMPOSITION OF ROCK UNDER THE ACTION OF WATER.

A continuation of the study of rock decomposition under the action of water, with special reference to the properties exhibited by various rock powders or rock dusts formed upon road surfaces, has been carried on during the past year. Much valuable information has been obtained along this line and data secured which have served to confirm the theories and principles set forth in previous publications of the Office. As an outgrowth of this work it has been found advisable in many cases to blend different kinds of rocks in road building. As an instance of this it may be noted that many limestones do not bind sufficiently well to form good macadam surfaces. The same thing is true of many of the siliceous types of rocks, such as sandstones, granites, etc. If, however, limestone and the siliceous rocks are used in conjunction with one another, a much higher bond is obtained than when either material is used alone. This fact was first discovered through laboratory work, but is now being put into successful practice in many of the States. In the States of Pennsylvania and Illinois it has been found particularly useful and has permitted the construction of more durable road surfaces than were possible before this principle was developed.

As another outgrowth of this work several possible methods of extracting potash from feldspathic rocks have been studied and the results obtained published in the Journal of the American Chemical Society by permission of the Secretary of Agriculture. Although at the present price of potash it is not likely that these methods will come into immediate use, it is probable that the contributions to the subject will be of great value at some future time.

PUBLICATIONS.

Reports of experiments made by the Office with various dust preventives in three different sections of the country were issued in Circular No. 89, supplementing Circular No. 47, which reported earlier experiments. A careful review of all substances which have been used for dust prevention, including discussions of their characteristic properties, methods of manufacture, and proper selection, has been published in Bulletin No. 34.

Two Farmers' Bulletins were published during the year, one on sand-clay and burnt-clay roads and another giving the construction and use of the split-log drag, a useful implement for the maintenance of earth roads. A revision has been made of Bulletin No. 29, on the construction of macadam roads, and it will soon be issued as Farmers' Bulletin No. 338, so great has been the demand for the earlier publication.

A report on the road materials of southern and eastern Maine has been prepared and will soon appear as Bulletin No. 33. This bulletin gives locality descriptions by townships and specially indicates the best road material which is available for the different cities and towns of the State. It also gives information in regard to the placing of quarries, economical shipment of stone, etc. A similar report on road materials and resources of Minnesota is to be prepared during the next fiscal year.

Plans for the coming year include the preparation of a treatise on the proper construction of concrete drains; also the compilation of data regarding road management and road laws in foreign countries, in State-aid States, and in States having county and township road systems.

The experimental work with processes for protecting iron from corrosion will be reported on whenever the results justify publication. Information supplemental to Bulletin No. 32, which gave the mileage of roads in this country in 1904, is being collected and will be prepared for publication.

CLASSIFIED EXPENDITURES FOR 1908, BY PROJECTS.

Expenditures for fiscal year ended June 30, 1908, by projects.

Appropriations:		
Salaries, Office of Public Roads		$12,390.00
"Public Road Inquiries"		57,660.00
Total appropriation		70,050.00
Projects:		
1. Object-lesson roads	$17,908.27	
2. Instruction in highway engineering	5,753.54	
3. Testing road materials	5,806.44	
4. Road management and accounting	1,387.25	
5. Lectures, addresses, and papers	3,815.64	
6. Special advice and inspection	4,961.00	
7. Dust prevention and dustless roads	2,901.89	
8. Inspection of rural-delivery routes	0	
9. Standardization of tests	75.19	
10. Introduction of model systems of construction, maintenance, and administration	1,353.93	
11. Investigation of road materials in the several States	219.65	
12. Sand-clay and burnt-clay roads	2,125.45	
13. Investigation of slag	613.30	
14. Cooperation with county newspapers	460.00	
15. Corrosion of iron and steel	1,375.34	
16. Split-log drag	233.31	
17. Classification of road materials	700.00	
18. Traction tests	0	
19. Bibliography on roads	368.00	
20. Rent	2,000.00	
21. Clerks, messengers, and laborers on lump fund	1,032.83	
22. Miscellaneous and contingent	4,696.32	
23. Machine shop	932.66	
24. Executive and administrative	3,289.99	
25. Editorial and library	1,200.00	
26. Correspondence and files	6,801.61	
Total expenditures		70,011.61
Balance unused—statutory roll		38.39

OUTLINE OF PLANS FOR THE CURRENT YEAR.

Until the close of the fiscal year 1908 the Office maintained an equipment of road-building machinery for use in object-lesson road work. Congress, at its last session, provided that no part of the appropriation for this Office should be used for the purchase or rental of road-building machinery. In order to carry out the spirit as well as the letter of the law, all road machinery borrowed from manufacturers has been returned to the factories, and such machinery as has been purchased by the Office in previous years is rapidly being condemned and sold. In this way the object-lesson road equipment will soon be entirely disposed of except three steam road rollers, concerning the disposition of which no definite decision has yet been reached.

It was at first thought that the discontinuance of the furnishing of road machinery would result in a decrease of activity under this project. Such, however, has not been the case, and the amount of work accomplished in the current year will probably exceed that of any previous year. From the fact that the work on the different object-lesson roads will be done with local equipment, there is reason to believe that an improvement when started will be continued, as no equipment will be withdrawn when the work of the Office is finished, as would necessarily be the case if Government machinery were used.

Arrangements are being made for more extensive cooperation in the giving of lectures in schools and colleges during the present year, and a definite and effective plan of cooperation embracing a large number of engineering and agricultural schools will probably soon be adopted.

The routine testing of road materials will continue as heretofore, but will assume increasing importance, owing to the cooperative investigation with the United States Geological Survey, which is described elsewhere in this report.

An investigation of road construction, maintenance, and administration in all foreign countries is now in progress through the American consular bureaus. At the same time an investigation is being inaugurated in this country on all phases of the same subject through the medium of a corps of 2,800 public road correspondents. A digest is now being prepared of the road laws in each State and Territory of the United States.

The demand for lectures by representatives of this Office is becoming so great that it is probable some restrictions will have to be adopted so as to eliminate all but the most important work of this kind.

The general advisory work of the Office is constantly broadening in scope and increasing in amount, and the policy of selecting for work under this project men who have had most thorough training and experience is resulting in the formation of a corps of high-grade consulting highway engineers who will materially advance road work in this country.

The work under the project "dust prevention" is being continued during the present year, and tentative specifications for tars and oils have been prepared for the use of those who care to profit by the experience of the Office. Up to the present year most of the field work has been in the line of surface application, but plans are now being made to give the subject of bituminous macadam and bituminous earth-road construction careful study. Work of this kind will be conducted in the States of Massachusetts, Illinois, Kansas, and Alabama, and it is believed that much valuable information will be derived from the experiments. Macadam roads constructed with the addition of asphaltic compounds, residual oils, specially prepared coal tars, and saccharine compounds have already been built, and experiments along the same general lines have been planned, using slag as a road material in place of stone.

The inspection of rural-delivery roads and advice concerning their improvement will follow the same plan during the current year as in previous years. The introduction of model systems of construction, maintenance, and administration in counties will be made a special feature of this year's work, as it is realized that by bringing about a general improvement in the road work of an entire county more lasting benefit results than would be possible by advice or demonstrations in single instances. The first county to receive assistance under this project during the current year is Fresno County, Cal.

The investigation of road materials in the several States in cooperation with the United States Geological Survey will continue in the manner explained in the report for the fiscal year just closed.

Encouraging results are promised in the introduction of the sand-clay method of road building in the prairie States. The first experiment conducted by the Office was at Englewood, Kans., and a report has just been received that thus far the road is a complete success. Additional roads of this character are being constructed in Kansas, and the method will shortly be given a trial in Nebraska. It is impossible to make authoritative announcement as to the merits of the sand-clay road in the prairie States until the sections of road constructed have been subjected to the severe climatic effects of winter. However, the situation at present is encouraging, and thorough demonstration will be made during the year.

Burnt-clay road work will be continued, and the scope of the investigation will be widened to permit thorough laboratory and field tests of materials and fuel.

Preparations are being made for extensive tests of blast-furnace slag by various treatments and under various conditions. At the present time experiments with slag and asphalt are being conducted at Chicago, Ill., and with slag and tar at Birmingham, Ala. Additional tests will be made in the spring.

It is probable that great progress will be made during the present year in the development of the work on the corrosion of iron and steel. The test fences erected at Pittsburg and Atlantic City will be inspected and their condition noted from time to time. From the information obtained by these inspections it is hoped that manufacturers will be in a position to manufacture steel more highly resistant to corrosive influences. The Atlantic City test should result in the selection of typical paint formulæ for substances which farmers can themselves apply to fences, corrugated roofs, sheathing, etc., so as to protect these constructions for much longer periods of time, and at very little trouble or expense.

There is a great demand for the development of some test which will enable consumers to tell in advance whether or not a given type of material is or is not specially adapted for use where there is danger of rapid corrosion. No such test is known up to the present time, and efforts will be made to develop such a test in the laboratory. Already a considerable amount of work has been done along these lines with encouraging results. In nearly every case this work is being done in cooperation with specially appointed agents of the leading iron and steel manufacturing interests, and every effort will be made to make them thoroughly practical and generally useful.

In the act making appropriation for the Government exhibit at the Alaska-Yukon-Pacific Exposition it was specifically provided that the Office of Public Roads should be represented. Accordingly, plans are now being perfected for an exhibit which it is hoped will have much educational value. The exact character of the exhibit has not yet been definitely decided upon, but it is hoped to have a miniature demonstration of road building with a complete equipment of road machinery which will illustrate every form of construction. This will be supplemented by a moving picture and stereopticon exhibit, a suitable handbook, and a series of lectures.

Efforts will be continued to bring about the general use of the split-log drag in the maintenance of earth roads, and experts will be especially assigned to deliver lectures and give demonstrations in the use of this simple and inexpensive implement.

A series of traction tests will be conducted during the current year with an equipment especially designed for the purpose. The first test has already begun at Memphis, Tenn. The tests will continue throughout the year at Manhattan, Kans.

PLANS AND RECOMMENDATIONS FOR 1910.

The scope of the work under established projects will be broadened if the following recommended increases are granted by Congress: Object-lesson roads, $1,500; instruction in highway engineering, $5,500; testing of road materials, $500; special advice and inspection, $2,800; dust prevention and dustless roads, $8,900; inspection of rural-delivery roads, $2,800; introduction of model systems of construction, maintenance, and administration, $4,100; sand-clay roads, $4,400; burnt-clay roads, $4,300; investigation of slag, $2,300; corrosion of iron and steel, $1,000; split-log drag, $1,500. No new projects are contemplated, but it will be the endeavor of the Office to perfect and broaden the work under the projects already established.

In view of the fact that the preservation of our macadam roads and the suppression of dust have become so important, it is contemplated that more far-reaching experiments will be conducted during the next fiscal year. Considerable laboratory investigation is necessary to obtain a proper understanding of the subject, which is exceedingly complex owing to the great variety of materials employed as binders and to the variations encountered in different lots of the same class of compounds. It is the idea of the Office so far as is possible to devise simple and practical tests which can be used by field men to determine whether or not the binding material they may have occasion to use is in accordance with predetermined standards. Every effort will be made to perfect this branch of the work which has so far been greatly neglected by experimenters.

One of the greatest difficulties encountered in determining the relative value of different dust preventives and road preservatives has been that as a rule the various materials have been employed on roads which often differ widely in characteristics as well as in quality and quantity of traffic, and are subject to many other variations in local conditions. During the coming year the Office hopes to secure a long stretch of road which may be divided into sections as nearly alike as possible. As many different materials as possible will then be tried upon this road and the results carefully recorded. An accurate record of traffic conditions, climatic conditions, cost of construction and application, cost of maintenance, character of binder, etc., will also be kept in order to obtain all the information necessary for an intelligent comparison. It is hoped that all manufacturers of dust preventives and road preservatives whose products are in any way suitable for this test will supply sufficient material to cover a section of the road and, if they desire, have a representative present when their material is applied. It should be understood that the results of this test will be published without reference to trade names so that they can not be used for advertising purposes. The character and quality of the materials used, as determined by physical and chemical examinations, will, however, be published for the mutual benefit of the consumer who wishes to purchase the best material obtainable and the manufacturer who wishes to produce the best article possible.

REPORT OF THE APPOINTMENT CLERK.

U. S. Department of Agriculture,
Office of the Appointment Clerk,
Washington, D. C., September 15, 1908

Sir: I have the honor to submit herewith my annual report respecting the officers, employees, etc., constituting the body of the United States Department of Agriculture as it existed on July 1, 1908, and various addenda relating thereto.

Very respectfully,
J. B. Bennett,
Appointment Clerk.

Hon. James Wilson,
Secretary of Agriculture.

CHANGES IN THE FORCE OF THE DEPARTMENT.

Summary of appointments, promotions, removals, etc., in the United States Department of Agriculture during the fiscal year ended June 30, 1908.

IN THE CLASSIFIED CIVIL SERVICE.

Number of persons appointed from the eligible registers of the Civil Service Commission for a probationary period of six months, equivalent to absolute appointment if retained in the service at the termination of the said probationary period	1,657
Number of persons who have been reinstated in the service of the Department within one year after having resigned or having been separated therefrom	69
Number of persons transferred from other Departments of the United States Government to the United States Department of Agriculture	63
Number of persons promoted in salary	2,111
Number of persons reduced in salary	102
Number of temporary or emergency appointments in the classified civil service, in accordance with civil-service rules, for periods of six months or less, for service in Washington, D. C., and who are separated from the service when the emergency that caused their appointments has ended, generally within one month and rarely continuing six months	773
Number of temporary or emergency appointments in the classified civil service, in accordance with civil-service rules, for periods of six months or less, conditioned as above, in the forests and fields and on stations in the various States outside of Washington, D. C	1,806
Number of persons who declined to accept appointments in the Department	128
Number of persons who resigned their positions in the Department	574
Number of persons who were removed from the service of the Department because of their misconduct	41
Number of persons who died while in the service of the Department	41

IN SPECIAL POSITIONS EXCEPTED FROM EXAMINATION UNDER CIVIL-SERVICE RULES.

Number of persons appointed to positions which are in the classified civil service, but which are excepted from civil-service examination according to civil-service rules, the appointments being for very temporary periods in the forests and fields or on stations in the various States outside of Washington, D. C., in the great majority of cases, comparatively few being stationed in Washington, D. C	2,079

IN THE UNCLASSIFIED SERVICE (POSITIONS OF MERE MANUAL LABORER).

Appointments in the District of Columbia	39
Promotions in salary in the District of Columbia	34
Reductions in salary in the District of Columbia	2
Separations from the service in the District of Columbia	31
Number of persons appointed in the forests and fields and on stations in the various States outside of Washington, D. C., being in the laborer grade, the appointments being for very short periods, usually averaging not more than three months	11,143
Number of temporary or emergency appointments in the labor grade in the District of Columbia	190
Total number of appointments of every description, including those for service in Washington, D. C., and those for service outside of Washington, D. C., in cattle and meat inspection, on forest reserves, on experiment stations and experiment farms, etc., of which number the great majority were of a temporary character and for a limited period	17,819

DEATHS IN THE DEPARTMENT.

During the fiscal year ended June 30, 1908, there were recorded 41 deaths among the officers and employees of the entire United States Department of Agriculture, as shown in the following table:

Name.	State.	Position.	Bureau, Division, or Office.	Salary.	Date of death.	Age.
					1907.	
George E. Wallace	W.Va.	Printer	Weather Bureau	$1,000	July 13	38
Bert Cuppernel	Ill.	Clerk	Plant Industry	1,200	July 2	63
Laomer West	Cal.	Veterinary inspector	Animal Industry	1,800	Aug. 4	54
George A. Robinson	Nebr.	Field stock examiner	do	1,200	Aug. 12	40
Leland E. Bousier	Pa.	Tagger	do	720	Aug. 20	26
Edward Dillon	D. C.	Skilled mechanic	Weather Bureau	1,000	Sept. 3	59
Peter Wood	Pa.	Assistant observer	do	840	Sept. 29	49
Thos. L. Armstrong	Ind.	Veterinary inspector	Animal Industry	1,800	Sept. 25	62
Marie A. S. Coleman	Mich.	Clerk translator	Library	1,200	Sept. 11	71
Daniel J. Walsh	Nebr.	Meat inspector	Animal Industry	1,000	Oct. 3	32
Otto L. Blue	Ind.	Assistant observer	Weather Bureau	1,000	Oct. 13	28
George H. Thayer	Cal.	Meat inspector	Animal Industry	1,000	Oct. 21	46
Joseph E. Blondell	Md.	Tagger	do	900	Oct. 23	51
Alfred B. Hollis	Iowa.	Veterinary inspector	do	1,600	Oct. 28	31
John D. Leland	N. Y.	Examiner	Forest Service	2,000	Nov. 4	68
Robt. H. Drummond	Ind. T.	Veterinary inspector	Animal Industry	1,400	Dec. 5	49
Rosie B. Blankman	N. Y.	Clerk	Statistics	1,000	Dec. 11	39
Frank Ridgeway	Pa.	Local forecaster	Weather Bureau	2,000	Dec. 31	48
					1908.	
John C. West	Mont.	Assistant forest ranger	Forest Service	900	Jan. 2	51
John N. Fitzgerald	Ill.	Clerk	Animal Industry	1,200	Jan. 5	40
David Cootin	Idaho.	Forest ranger	Forest Service	1,200	Jan. 13	50
Nathan Eddy	Pa.	Assistant observer	Weather Bureau	840	Jan. 15	70
Omar Stoddard	Mich.	Meat inspector	Animal Industry	1,000	do	49
Percy Gardner	Cal.	Forest ranger	Forest Service	1,200	Feb. 4	26
William N. Talbot	D. C.	Watchman	Soils	720	do	61
Thomas S. Collins	Mo.	Observer	Weather Bureau	1,200	Feb. 23	60
Allen Dodge	D. C.	Clerk and pomologist	Plant Industry	1,200	Mar. 6	85
William O. Harvey	Pa.	Watchman	Weather Bureau	720	Apr. 14	66
May Jones	D. C.	Laborer and charwoman	Statistics	540	Apr. 19	37
Ida L. Doyle	N. C.	Messenger	Plant Industry	840	Apr. 23	38
Harry A. Shatzell	Nebr.	Skilled laborer	Animal Industry	900	Apr. 1	64
Frank T. Williams	N. Y.	Local forecaster	Weather Bureau	1,400	Apr. 6	47
Charles M. Railey	Mont.	Assistant forest ranger	Forest Service	900	Apr. 22	24
Nina G. Holton	Mass.	Assistant curator	Plant Industry	1,200	May 5	44
William M. Husson	N. Y.	Clerk	Weather Bureau	1,400	May 10	52
Herbert L. Belden	Ohio.	Scientific assistant	Soils	1,200	May 24	30
H. Maria Patton	W.Va.	Clerk	Animal Industry	720	May 27	43
James L. Seckner	Ariz.	Assistant forest ranger	Forest Service	900	May 28	31
Silas L. McKee	Oreg.	Deputy forest ranger	do	1,000	June 8	38
Wm. S. Canatsey	Kans.	Messenger	Entomology	840	June 10	65
Mary Johnson	D. C.	Unskilled laborer	Office Secretary	240	June 15	30

ESTABLISHMENT AND GROWTH OF THE DEPARTMENT OF AGRICULTURE.

The Department of Agriculture was established July 1, 1862, according to the provisions of an act approved May 15, 1862 (vol. 12, chap. 72, pp. 387, 388, U. S. Stat. L.).

Growth of the force of the Department from September 30, 1863, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
1863, September 30	29	1893, July 1	1,870
1867, September 30	99	1895, July 1	2,043
1871, September 30	84	1897, July 1	2,444
1873, September 30	92	1899, July 1	2,965
1875, September 30	90	1900, November 16	3,128
1877, September 30	77	1901, July 1	3,388
1879, June 30	93	1902, July 1	3,789
1881, July 1	108	1903, July 1	4,200
1883, July 1	239	1904, July 1	4,504
1885, July 1	214	1905, July 1	5,446
1887, July 1	328	1906, July 1	6,242
1889, July 1	488	1907, July 1	9,107
1891, July 1[a]	1,577	1908, July 1	10,420

[a] The large increase on July 1, 1891, resulted from the transfer of the Weather Bureau to the Department of Agriculture on that date.

NOTE.—The apparent discrepancy of 9 between the total number of officers and employees on July 1, 1901, and July 1, 1903, as reported on this page, and the number reported on page 12, is explained by the discontinuance of the Department museum by Congressional action.

Increase from July 1, 1897, to July 1, 1908, 7,876.

The following statements show the increases in the number of persons employed in various branches of the Department.

OFFICE OF THE SECRETARY.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	26	July 1, 1897	90
July 1, 1883	48	July 1, 1899	85
July 1, 1885	47	July 1, 1901	65
July 1, 1887	56	July 1, 1903	70
July 1, 1889	45	July 1, 1905	115
July 1, 1891	55	July 1, 1907	105
July 1, 1893	66	July 1, 1908	131
July 1, 1895	72		

WEATHER BUREAU.

The Weather Bureau was transferred from the Signal Corps in the War Department to the Department of Agriculture by act of Congress approved October 1, 1890, and effective July 1, 1891.

Growth of total force employed from July 1, 1891, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1891	818	July 1, 1901	1,185
July 1, 1893	921	July 1, 1903	1,410
July 1, 1895	892	July 1, 1905	1,540
July 1, 1897	1,075	July 1, 1907	1,694
July 1, 1899	1,163	July 1, 1908	1,705

BUREAU OF ANIMAL INDUSTRY.

The number of persons investigating diseases of domestic animals July 1, 1881, was 8.

The number of persons investigating diseases of domestic animals July 1, 1883, was 8.

The Bureau of Animal Industry was established by an act of Congress approved May 29, 1884.

Growth of total force employed from July 1, 1885, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1885	24	July 1, 1899	1,106
July 1, 1887	61	July 1, 1901	1,286
July 1, 1889	174	July 1, 1903	1,386
July 1, 1891	334	July 1, 1905	1,475
July 1, 1893	495	July 1, 1907	3,182
July 1, 1895	709	July 1, 1908	3,152
July 1, 1897	777		

The work of the Bureau of Animal Industry was greatly increased by the act of Congress of June 30, 1906, requiring the supervision of all slaughtering establishments engaged in the preparation of meat and meat food products for shipment in interstate commerce. The appropriation for this work was increased to $3,000,000, whereas the amount expended by the Bureau under the previous law was about $750,000. In addition, the Bureau was instructed by Congress to take up the work of eradicating cattle ticks from the Southern States. These ticks are the agencies by which the infectious disease of cattle known as "Texas fever" is distributed, and are a great detriment to the raising of cattle in that section of the country. The work of the Bureau was also increased by additional appropriations for the purpose of eradicating scabies in cattle and sheep, and this work was taken up in nearly every State and Territory west of the Mississippi River.

BUREAU OF PLANT INDUSTRY.

The Bureau of Plant Industry was established by Congress by the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1902, approved March 2, 1901. It was a consolidation of the former divisions of botany, pomology, vegetable physiology and pathology, agrostology, experimental gardens and grounds, and seeds.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	41	July 1, 1897	127
July 1, 1883	56	July 1, 1899	159
July 1, 1885	28	July 1, 1901	203
July 1, 1887	33	July 1, 1903	325
July 1, 1889	83	July 1, 1905	509
July 1, 1891	105	July 1, 1907	807
July 1, 1893	131	July 1, 1908	976
July 1, 1895	132		

The increase in the force of the Bureau of Plant Industry is due to the increase in the demands on that Bureau for scientific work and information respecting seeds, plants, and crops of all kinds from different parts of the country.

FOREST SERVICE.

The Division of Forestry was established July 1, 1880, by Congress. Its designation was changed by Congress to "Bureau of Forestry," becoming effective July 1, 1901, and changed to "Forest Service," becoming effective July 1, 1905.

Growth of total force employed from July 1, 1880, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1880	1	July 1, 1895	10
July 1, 1881	2	July 1, 1897	14
July 1, 1883	4	July 1, 1899	54
July 1, 1885	3	July 1, 1901	192
July 1, 1887	7	July 1, 1903	297
July 1, 1889	7	July 1, 1905	939
July 1, 1891	10	July 1, 1907	2,012
July 1, 1893	10	July 1, 1908	2,753

The work of the Forest Service has been greatly increased by acts of Congress placing the National Forests under its supervision, the area of which amounted to 168,000,000 acres on July 1, 1908.

BUREAU OF CHEMISTRY.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	8	July 1, 1897	20
July 1, 1883	11	July 1, 1899	26
July 1, 1885	8	July 1, 1901	29
July 1, 1887	13	July 1, 1903	50
July 1, 1889	20	July 1, 1905	97
July 1, 1891	27	July 1, 1907	250
July 1, 1893	24	July 1, 1908	425
July 1, 1895	24		

The increase in the force of the Bureau of Chemistry in 1903 and 1905 was due to the establishment of branch laboratories in various cities of the United States for the purpose of inspecting imported food products, as authorized by appropriation bills. The increase to July 1, 1908, is due to the work involved in the enforcement of the food and drugs act, June 30, 1906

BUREAU OF SOILS.

The division of agricultural soils was established in the Weather Bureau March 3, 1894. The "Division of Soils" was established as an independent division in the Department on July 1, 1896, and its title changed to Bureau of Soils on July 1, 1901.

Growth of total force employed from July 1, 1895, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1895	10	July 1, 1903	130
July 1, 1897	33	July 1, 1905	130
July 1, 1899	15	July 1, 1907	116
July 1, 1901	57	July 1, 1908	118

BUREAU OF STATISTICS.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	3	July 1, 1897	133
July 1, 1883	86	July 1, 1899	132
July 1, 1885	66	July 1, 1901	145
July 1, 1887	95	July 1, 1903	151
July 1, 1889	82	July 1, 1905	155
July 1, 1891	100	July 1, 1907	149
July 1, 1893	111	July 1, 1908	181
July 1, 1895	85		

BUREAU OF ENTOMOLOGY.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	4	July 1, 1897	21
July 1, 1883	15	July 1, 1899	23
July 1, 1885	20	July 1, 1901	26
July 1, 1887	4	July 1, 1903	34
July 1, 1889	31	July 1, 1905	88
July 1, 1891	28	July 1, 1907	281
July 1, 1893	25	July 1, 1908	440
July 1, 1895	20		

The figures for July 1, 1908, include temporary emergency workers in the Bureau employed for short periods in the work of preventing the spread of moths in districts infested by them outside of Washington, D. C., and temporary emergency workers employed in the cotton boll weevil investigations in weevil-infested districts outside of Washington, D. C.

BUREAU OF BIOLOGICAL SURVEY.

The Division of Economic Ornithology and Mammalogy was established July 1, 1887, by Congress. That title was changed to "Division of Biological Survey" July 1, 1896, by Congress; and again to "Bureau of Biological Survey" July 1, 1905.

Growth of total force employed from July 1, 1887, to July 1, 1908.

Date.	Number employed.	Date.	Number employed
July 1, 1887	6	July 1, 1899	23
July 1, 1889	9	July 1, 1901	21
July 1, 1891	13	July 1, 1903	30
July 1, 1893	14	July 1, 1905	37
July 1, 1895	19	July 1, 1907	38
July 1, 1897	23	July 1, 1908	45

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	2	July 1, 1897	
July 1, 1883	3	July 1, 1899	10
July 1, 1885	3	July 1, 1901	10
July 1, 1887	3	July 1, 1903	12
July 1, 1889	9	July 1, 1905	16
July 1, 1891	11	July 1, 1907	22
July 1, 1893	11	July 1, 1908	31
July 1, 1895	10		34

DIVISION OF PUBLICATIONS.

The Division of Publications was established July 1, 1895, by Congress in the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1896, approved March 2, 1895; it absorbed and succeeded the "Division of Records and Editing," which was established July 1, 1890, by Congress in the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1891, approved July 14, 1890.

The work of preparing illustrations and engravings for the publications issued by the Department, and the fund appropriated by Congress therefor, were assigned to the Division of Records and Editing on July 1, 1894, by the Secretary of Agriculture.

The "document and folding room" of the Department was placed in charge of the Chief of the Division of Publications, by order of the Chief Clerk of the Department, on July 1, 1896, and was transferred to the Division of Publications as the "document section" July 1, 1897, by Congress in the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1898, approved April 23, 1897.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	1	July 1, 1897	61
July 1, 1883	3	July 1, 1899	81
July 1, 1885	3	July 1, 1901	142
July 1, 1887	5	July 1, 1903	164
July 1, 1889	9	July 1, 1905	166
July 1, 1891	30	July 1, 1907	182
July 1, 1893	22	July 1, 1908	188
July 1, 1895	21		

LIBRARY.

Growth of total force employed from July 1, 1881, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	1	July 1, 1897	6
July 1, 1883	1	July 1, 1899	6
July 1, 1885	1	July 1, 1901	8
July 1, 1887	1	July 1, 1903	11
July 1, 1889	2	July 1, 1905	16
July 1, 1891	2	July 1, 1907	15
July 1, 1893	1	July 1, 1908	18
July 1, 1895	2		

OFFICE OF EXPERIMENT STATIONS.

The Office of Experiment Stations was established July 1, 1888, by act of Congress.

Growth of total force employed from July 1, 1889, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1889	8	July 1, 1901	122
July 1, 1891	26	July 1, 1903	106
July 1, 1893	18	July 1, 1905	116
July 1, 1895	27	July 1, 1907	174
July 1, 1897	38	July 1, 1908	[a] 187
July 1, 1899	60		

[a] A number of these are temporary emergency employees, employed for short periods in the field in nutrition, irrigation, and drainage investigations.

OFFICE OF PUBLIC ROADS.

The Office of Public Road Inquiries was established July 1, 1893, by Congress. It was given a statutory organization, with the title Office of Public Roads, on July 1, 1905.

Growth of total force employed from July 1, 1893, to July 1, 1908.

Date.	Number employed.	Date.	Number employed.
July 1, 1893	1	July 1, 1903	26
July 1, 1895	5	July 1, 1905	41
July 1, 1897	7	July 1, 1907	56
July 1, 1899	6	July 1, 1908	65
July 1, 1901	12		

PLACE OF EMPLOYMENT.

The table on page 11 shows the total number of officers and employees in the different branches of the United States Department of Agriculture on July 1, 1908, the number stationed in Washington, D. C., and the number employed outside of Washington, D. C.

Number of officers and employees stationed at Washington and outside of Washington.

Branch of the Department.	Number of officers and employees.		
	Washington, D. C.	Outside of Washington, D. C.	Total.
Office of the Secretary	131	....	131
Weather Bureau	198	1,507	1,705
Bureau of Animal Industry	304	2,848	3,152
Bureau of Plant Industry	499	477	976
Forest Service	555	2,198	2,753
Bureau of Chemistry	184	241	425
Bureau of Soils	68	50	118
Bureau of Statistics	115	66	181
Bureau of Entomology	65	375	440
Bureau of Biological Survey	30	15	45
Division of Accounts and Disbursements	34	....	34
Division of Publications	188	....	188
Library	18	....	18
Office of Experiment Stations	67	120	187
Office of Public Roads	30	35	65
Employed in connection with the completion of the Department's new buildings	2	....	2
Total	2,488	7,932	10,420

PAY-ROLL CLASSIFICATION OF FORCE.

The following statement shows the number of persons, on July 1, 1908, occupying statutory positions on what are known as the statutory rolls of the Department, being specific positions especially created by act of Congress making appropriations for the United States Department of Agriculture; also the total number of persons in the said Department paid from miscellaneous or lump-sum funds appropriated by act of Congress as aforesaid, in which specific positions are not created.

Officers and employees of Department on statutory roll and those paid from lump-sum funds July 1, 1908.

Bureau, Division, Office, etc.	Statutory.	Lump sum.	Total.
Office of the Secretary	116	15	131
Weather Bureau	186	1,519	1,705
Bureau of Animal Industry	67	3,085	3,152
Bureau of Plant Industry	193	783	976
Forest Service	150	2,603	2,753
Bureau of Chemistry	60	365	425
Bureau of Soils	29	89	118
Bureau of Statistics	80	101	181
Bureau of Entomology	19	421	440
Bureau of Biological Survey	6	39	45
Division of Accounts and Disbursements	34	....	34
Division of Publications	160	28	188
Library	18	....	18
Office of Experiment Stations	33	154	187
Office of Public Roads	10	55	65
New buildings	....	2	2
Total	1,161	9,259	10,420

HEADS OF THE DEPARTMENT OF AGRICULTURE.

The table on page 12 shows the name and length of service of each Commissioner and of each Secretary of Agriculture since the organization of the United States Department of Agriculture, July 1, 1862.

Commissioners and Secretaries of Agriculture since July 1, 1862.

Name.	Rank.	Appointed under the administration of President—	When appointed.	Service terminated.
Isaac Newton	Commissioner	Lincoln	July 1, 1862	June 19, 1867
John W. Stokes	do	Johnson	June 20, 1867	Dec. 4, 1867
Horace Capron	do	do	Dec. 5, 1867	July 31, 1871
Frederick Watts	do	Grant	Aug. 1, 1871	June 30, 1877
Wm. G. Le Duc	do	Hayes	July 1, 1877	June 30, 1881
Geo. B. Loring	do	Garfield	July 1, 1881	Apr. 3, 1885
Norman J. Colman	do	Cleveland	Apr. 4, 1885	Feb. 12, 1889
Do	Secretary	do	Feb. 13, 1889	Mar. 6, 1889
J. M. Rusk	do	Harrison	Mar. 7, 1889	Mar. 6, 1893
J. Sterling Morton	do	Cleveland	Mar. 7, 1893	Mar. 5, 1897
James Wilson	do	McKinley	Mar. 6, 1897	
Do	do	do	Mar. 6, 1901	
Do	do	Roosevelt	Mar. 6, 1905	

NUMBER OF OFFICERS AND EMPLOYEES, 1901-1908.

Number of officers and employees on the rolls of the Department of Agriculture, in the several Bureaus and Divisions thereof, on the dates stated, and the increase and decrease in numbers during the period from July 1, 1901, to July 1, 1908.

Bureaus, Divisions, and Offices.	Number on rolls July 1, 1901.	Number on rolls July 1, 1903.	Increase from July 1, 1901, to July 1, 1903.	Number on rolls July 1, 1905.	Increase from July 1, 1903, to July 1, 1905.
Office of the Secretary	61	65	4	115	50
Weather Bureau	1,185	1,410	225	1,540	130
Bureau of Animal Industry	1,204	1,386	182	1,475	89
Bureau of Plant Industry	203	325	122	509	184
Forest Service	192	297	105	939	642
Bureau of Chemistry	29	50	21	97	47
Bureau of Soils	58	130	72	130	
Bureau of Statistics	140	151	11	155	4
Bureau of Entomology	26	34	8	88	54
Bureau of Biological Survey	21	30	9	37	7
Division of Accounts and Disbursements	12	16	4	22	6
Division of Publications	142	154	12	166	12
Library	8	11	3	16	5
Office of Experiment Stations	86	106	20	116	10
Office of Public Roads	12	26	14	41	15
Total	3,379	4,191	812	5,446	1,255

Bureaus, Divisions, and Offices.	Number on rolls July 1, 1907.	Increase from July 1, 1905, to July 1, 1907.	Decrease from July 1, 1905, to July 1, 1907.	Number on rolls July 1, 1908.	Increase from July 1, 1907, to July 1, 1908.	Decrease from July 1, 1907, to July 1, 1908.	Total net increase in Bureaus, etc.
Office of the Secretary	109		6	131	22		70
Weather Bureau	1,694	154		1,705	11		520
Bureau of Animal Industry	3,182	1,707		3,152		30	1,948
Bureau of Plant Industry	807	298		976	169		773
Forest Service	2,012	1,073		2,753	741		2,561
Bureau of Chemistry	250	153		425	175		396
Bureau of Soils	116		14	118	2		60
Bureau of Statistics	149		6	181	32		41
Bureau of Entomology	281	193		440	159		414
Bureau of Biological Survey	38	1		45	7		24
Division of Accounts and Disbursements	31	9		34	3		22
Division of Publications	182	16		188	6		46
Library	15		1	18	3		10
Office of Experiment Stations	174	58		187	13		101
Office of Public Roads	56	15		65	9		53
New building fund	11	11		2		9	2
Total	9,107	3,688	27	10,420	1,352	39	7,041

PRINCIPAL OFFICERS OF THE DEPARTMENT.

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1908.

OFFICE OF THE SECRETARY.

Position.	Name.	Salary per annum.
Secretary of Agriculture	James Wilson	$12,000
Assistant Secretary	Willet M. Hays	5,000
Chief Clerk and custodian of buildings	Sylvester R. Burch	3,000
Solicitor	George P. McCabe	4,000
Appointment Clerk	Joseph B. Bennett	2,000
Private secretary to the Secretary of Agriculture	Jasper Wilson	2,500
Private secretary to the Assistant Secretary of Agriculture.	H. H. Mowry	1,600
Chief of supply division	Cyrus B. Lower	2,000
Chief engineer and captain of the watch	Lewis Jones	1,600

WEATHER BUREAU.

[Corner Twenty-fourth and M streets NW. Phone, West 74.]

Chief	Willis L. Moore	$5,000
Assistant	Henry E. Williams	3,000
Chief clerk	Daniel J. Carroll	2,250
Editor of Monthly Weather Review	Prof. Cleveland Abbe	3,000
In charge of—		
Climatological Division	Prof. Frank H. Bigelow	3,000
Instrument Division	Prof. Charles F. Marvin	3,000
Forecast Division	Prof. Edward B. Garriott	3,000
River and Flood Service	Prof. Harry C. Frankenfield	3,000
Accounts	Edgar B. Calvert	2,500
Chiefs of division:		
Distributing	James Berry	2,750
Publications	John P. Church	2,000
Telegraph	Jesse H. Robinson	2,000
Marine meteorology	Henry L. Heiskell	2,000
Supplies	Frank M. Cleaver	2,000
Librarian	Charles F. Talman	2,000
In charge of forecast districts:		
Chicago, Ill	Prof. Henry J. Cox	3,000
San Francisco, Cal	Prof. Alexander G. McAdie	3,000
District forecasters:		
Boston, Mass	John W. Smith	2,400
Portland, Oreg	Edward A. Beals	2,400
New Orleans, La	Isaac M. Cline	2,400
Denver, Colo	Frederick H. Brandenburg	2,400
Louisville, Ky	Ferdinand J. Walz	2,400
Inspectors:		
Detroit, Mich	Norman B. Conger	2,500
Milwaukee, Wis	Henry B. Hersey	2,500
Research staff, Mount Weather, Va.		
Executive officer in charge	Prof. Alfred J. Henry	3,000
In charge of—		
Physical laboratory	Prof. William J. Humphreys	3,000
Solar-radiation work	Prof. Herbert H. Kimball	2,500
Upper-air research	William R. Blair	2,000
Magnetic research	Eric R. Miller	1,400

BUREAU OF ANIMAL INDUSTRY.

Chief	Alonzo D. Melvin	$5,000
Assistant Chief	Arthur M. Farrington	3,000
Chief clerk	Charles C. Carroll	2,000
Chiefs of division:		
Dairy	Ed. H. Webster	2,750
Inspection	Rice P. Steddom	3,000
Quarantine	Richard W. Hickman	2,750
Animal husbandman	George M. Rommel	2,500
Editor	James M. Pickens	2,000
Laboratories.		
Chiefs of division:		
Biochemic	Marion Dorset	3,500
Pathological	John R. Mohler	3,500
Zoology	Brayton H. Ransom	2,500
Experiment Station, Bethesda, Md.		
Superintendent	E. C. Schroeder	3,000

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1908—Continued.

BUREAU OF PLANT INDUSTRY.

Position.	Name.	Salary per annum.
Administration.		
Pathologist and Physiologist and Chief of Bureau	Beverly T. Galloway	$5,000
Pathologist and Physiologist and Assistant Chief of Bureau.	Albert F. Woods	3,500
Chief clerk	James E. Jones	2,250
Editor	J. E. Rockwell	2,000
Pathology.		
Pathologist in charge of laboratory of plant pathology.	Erwin F. Smith	3,000
Pathologist in charge of investigations of fruit diseases.	Merton B. Waite	2,750
Pathologist in charge of cotton and truck crop disease investigations.	William A. Orton	2,250
Pathologist in charge of laboratory of forest pathology.	Haven Metcalf	2,000
Physiology.		
Physiologist in charge of plant life history investigations.	Walter T. Swingle	3,000
Physiologist in charge of soil bacteriology and water purification investigations.	Karl F. Kellerman	2,250
Bionomist in charge of bionomic investigations	O. F. Cook	2,750
Physiologist in charge of drug plant, poisonous plant, and tea culture investigations.	Rodney H. True	2,750
Technology.		
Crop technologist in charge of crop technology investigations.	Nathan A. Cobb	3,000
Botanist in charge of fiber investigations	Lyster H. Dewey	2,500
Crop technologist in charge of grain standardization	John D. Shanahan	3,000
Physicist in charge of physical laboratory	Lyman J. Briggs	2,750
Botanist in charge of seed laboratory	Edgar Brown	2,250
Agronomy.		
Cerealist in charge of grain investigations	Mark A. Carleton	3,000
Physiologist in charge of tobacco investigations	A. D. Shamel	2,750
Expert in charge of cotton breeding investigations	D. N. Shoemaker	2,000
Physiologist in charge of alkali and drought resistant plant breeding investigations.	Thomas H. Kearney	2,500
Physiologist in charge of corn investigations	Charles B. Hartley	1,800
Pathologist in charge of sugar beet investigations	Charles O. Townsend	2,750
Botanist in charge of taxonomic and range investigations.	Frederick V. Coville	3,000
Demonstrations.		
Agriculturist in charge of farm management investigations.	W. J. Spillman	3,500
Special agent in charge of farmers' cooperative demonstration work.	Seaman A. Knapp	3,000
Agriculturist in charge of dry land agriculture investigations.	E. C. Chilcott	2,750
Agriculturist in charge of western agricultural extension.	Carl S. Scofield	2,500
Horticulture.		
Horticulturist in charge of Arlington Experimental Farm and truck crop investigations.	L. C. Corbett	3,000
Superintendent of vegetable testing gardens	W. W. Tracy, sr	3,000
Pomologist in charge of pomological collections	G. B. Brackett	3,000
Pomologists in charge of field investigations in pomology.	G. Harold Powell	3,000
	Wm. A. Taylor	3,000
Superintendent of gardens and grounds	E. M. Byrnes	1,800
Seeds.		
Agricultural explorer in charge of foreign seed and plant introduction.	David Fairchild	2,750
Agrostologist in charge of forage crop investigations	C. V. Piper	2,750
Assistant in general charge of seed distribution	Lisle Morrison	2,250
Field gardens.		
Pathologist in charge of suptropical laboratory and garden, Miami, Fla.	Ernst A. Bessey	2,000
Pomologist in charge of South Texas Garden, Brownsville, Tex.	Edward C. Green	2,000
Botanist in charge of Plant Introduction Garden, Chico, Cal.	W. W. Tracy, jr	1,800

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1908—Continued.

FOREST SERVICE.

[Atlantic Building, 928-930 F street. Phone Main 3572.]

Position.	Name.	Salary per annum.
Forester	Gifford Pinchot	$5,000
Associate Forester	Overton W. Price	3,500
Editor	Herbert A. Smith	3,000
Dendrologist	George B. Sudworth	2,700
Expert lumberman	Eugene S. Bruce	3,000
Branch of Operation.		
Assistant forester, in charge	James B. Adams	3,200
Assistant forester	Chas. S. Chapman	2,500
Office of accounts:		
Fiscal agent and chief	H. B. Cramer	2,400
Assistant chief	E. A. Melzar	2,000
Office of maintenance:		
Chief	R. K. Helphenstine, jr	1,700
Office of engineering:		
Chief	W. E. Herring	2,400
Assistant chief	F. C. Wales	2,000
Office of organization:		
Chief	Clyde Leavitt	2,200
Assistant chief	Geo. H. Cecil	2,000
Branch of Silviculture.		
Assistant forester, in charge	William T. Cox	2,800
Assistant forester	E. E. Carter	2,500
Office of forest management:		
Chief	E. H. Clapp	2,200
Associate chief	W. B. Greeley	2,200
Office of cooperation:		
Chief	A. K. Chittenden	2,400
Assistant chief	W. G. Weigle	2,200
Office of silvics:		
Chief	Raphael Zon	2,200
Office of extension:		
Chief	Samuel N. Spring	2,200
Branch of Lands.		
Expert and assistant forester, in charge	P. P. Wells	3,000
Assistant forester	A. C. Ringland	2,000
Principal examiner	A. C. Shaw	2,700
Office of law:		
Chief	A. C. Shaw	2,700
Office of occupancy:		
Chief	M. J. McVean	2,100
Assistant chief	H. O. Stabler	1,600
Office of geography:		
Chief	F. G. Plummer	2,500
Branch of Grazing.		
Assistant forester	A. F. Potter	3,000
Office of control:		
Chief	L. F. Kneipp	2,200
Office of development:		
Acting chief	Will C. Barnes	2,200
Branch of Products.		
Assistant forester, in charge	William L. Hall	3,000
Assistant forester	R. S. Kellogg	2,300
Office of wood utilization:		
Chief	McGarvey Cline	2,000
Assistant chief	H. S. Betts	1,800
Office of wood preservation:		
Chief	W. F. Sherfesee	1,800
Office of publication:		
Chief	Findley Burns	1,800

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1908—Continued.

BUREAU OF CHEMISTRY.

Position.	Name.	Salary per annum.
Chemist and Chief of Bureau	H. W. Wiley	$5,000
Associate Chemist	F. L. Dunlap	3,500
Assistant Chief	W. D. Bigelow	3,500
Chief clerk	F. B. Linton	1,800
Chief, Washington food-inspection laboratory	L. M. Tolman	3,000
Chief of food and drug inspection	Walter G. Campbell	2,500
Chief of dairy laboratory	G. E. Patrick	2,500
Chief of miscellaneous division	J. K. Haywood	2,750
Chief of drug division	L. F. Kebler	3,000
Chief of contracts laboratory	P. H. Walker	2,500
Chief of leather and paper laboratory	F. P. Veitch	2,500
Chief of microchemical laboratory	B. J. Howard	2,250
In charge of:		
Animal physiology	F. C. Weber	2,000
Vegetable physiology	J. A. Le Clerc	2,500
Bacteriological chemistry	G. W. Stiles, jr.	2,000
Nitrogen section	T. C. Trescot	2,500

BUREAU OF SOILS.

Chief of Bureau	Milton Whitney	$3,500
Chief clerk	A. G. Rice	2,000
Soil chemist	Frank K. Cameron	3,250
In charge of:		
Soil survey, western division	C. W. Dorsey	2,750
Soil survey, eastern division	J. A. Bonsteel	3,250
Soil fertility investigations	Oswald Schreiner	2,750
Soil erosion	W J McGee	3,000

BUREAU OF STATISTICS.

Statistician and Chief	Victor H. Olmsted	$3,500
Associate Statistician	Charles C. Clark	3,000
Assistant Statistician	Nat. C. Murray	2,500
Chief clerk	Samuel A. Jones	1,800
Statistical scientists in charge of investigations of:		
Domestic crop reports	Fred. J. Blair	1,800
Production and distribution	George K. Holmes	3,000
Editorial and library	Charles M. Daugherty	2,500

BUREAU OF ENTOMOLOGY.

Entomologist and Chief	L. O. Howard	$4,000
Entomologist and Acting Chief in absence of Chief	C. L. Marlatt	3,000
Chief clerk	R. S. Clifton	1,800
In charge of:		
Breeding experiments	F. H. Chittenden	2,750
Forest-insect investigations	A. D. Hopkins	2,750
Southern field-crop insect and tick investigations	W. D. Hunter	2,750
Cereal and forage plant insect investigations	F. M. Webster	2,750
Deciduous-fruit insect investigations	A. L. Quaintance	2,750
Apicultural investigations	E. F. Phillips	2,250

BUREAU OF BIOLOGICAL SURVEY.

Biologist and Chief	C. Hart Merriam	$3,000
Administrative assistant, Acting Chief in absence of Chief	H. W. Henshaw	2,750
Assistants in charge of:		
Economic investigations	A. K. Fisher	2,500
Game preservation	T. S. Palmer	2,500
Geographic distribution	Vernon Bailey	2,500

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1908—Continued.

OFFICE OF EXPERIMENT STATIONS.

Position.	Name.	Salary per annum.
Director	A. C. True	$3,500
Assistant, and editor of Experiment Station Record	E. W. Allen	3,000
Chiefs of:		
Editorial division	W. H. Beal	2,500
Division of insular stations	Walter H. Evans	2,500
Nutrition investigations	C. F. Langworthy	2,400
Irrigation investigations	S. Fortier	3,000
Drainage investigations	C. G. Elliott	3,000
In charge of:		
Alaska experiment stations	C. C. Georgeson	3,000
Hawaii Experiment Station	Earley V. Wilcox	3,000
Porto Rico Experiment Station	David W. May	3,500
Agricultural education specialist	D. J. Crosby	2,200
Farmers' institute specialist	John Hamilton	2,250
Chief clerk	Mrs. C. E. Johnston	1,800

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Chief of Division and disbursing clerk	A. Zappone	$3,250
Assistant Chief of Division (in charge of Weather Bureau accounts)	E. B. Calvert	2,500
Chief clerk	M. E. Fagan	2,000
In charge of:		
Cashier's section	M. E. Fagan	2,000
Auditing section "A"	E. D. Yerby	2,000
Auditing section "B"	A. W. Smith	1,800
Bookkeeper's section	F. W. Legge	1,600
Freight and transportation section	E. E. Forbes	1,600
Miscellaneous section	W. J. Nevius	1,600

DIVISION OF PUBLICATIONS.

Editor and Chief	George William Hill	$3,000
Editor and Assistant Chief	Joseph A. Arnold	2,250
Associate Editor	B. D. Stallings	2,000
Chief clerk	A. I. Mudd	2,000
Assistants in charge of:		
Document section	Robert B. Handy	2,000
Indexing	C. H. Greathouse	1,800
Illustrations	L. S. Williams	2,000

LIBRARY.

Librarian	Claribel R. Barnett	$2,000
Assistant Librarian	Emma B. Hawks	1,400

OFFICE OF PUBLIC ROADS.

Director	Logan W. Page	$2,750
Assistant Director	A. S. Cushman	p. d. 10.00
Chief engineer	Vernon M. Peirce	2,500
Chief of road management	J. E. Pennybacker, jr	2,000
Testing engineer	P. L. Wormeley	1,800
Chief clerk	W. Carl Wyatt	1,600

CIVIL-SERVICE REGULATIONS GOVERNING PROMOTIONS, ETC., IN THE UNITED STATES DEPARTMENT OF AGRICULTURE.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 30, 1908.

The following regulations, having been duly promulgated by the honorable the United States Civil Service Commission and approved by the Secretary of Agriculture, will hereafter govern promotions, demotions, and continuance in office of employees in this Department, and they are accordingly published for the information of all concerned.

JAMES WILSON,
Secretary of Agriculture.

OFFICE OF UNITED STATES CIVIL SERVICE COMMISSION,
Washington, D. C., July 29, 1908.

In pursuance of the requirements of section 7 of "An act to regulate and improve the civil service of the United States," approved January 16, 1883, and in conformity with Rule XI of the revision of the civil-service rules promulgated by the President on the 15th day of April, 1903, the following regulations governing promotions in the Departmental service of the Department of Agriculture have been formulated by the Civil Service Commission after consultation with the Secretary of Agriculture, and are hereby promulgated:

REGULATION I.

SECTION 1. All vacancies above those in the lowest class of any grade not filled by reinstatement, transfer, or reduction shall be filled by promotion: *Provided,* That if there is no person eligible for promotion, or if the vacant position requires the exercise of technical or professional knowledge, it may be filled through certification by the Civil Service Commission.

SEC. 2. Except as provided in section 1 of this regulation, a vacancy in any class shall be filled by promotion of an eligible in the next lower class of the same Bureau, Division, or Office. When such vacancy exists the board of promotion review shall certify to the Secretary of Agriculture the names of the three eligibles in the Bureau, Division, or Office having the highest records of efficiency, and from these names the Secretary of Agriculture shall make his selection.

REGULATION II.

SECTION 1. No person shall be promoted to any grade from which he is barred by the age limitations prescribed by the civil-service rules.

SEC. 2. No person whose record of efficiency is below 85 per cent of the possible maximum rating of his class or grade shall be eligible for promotion.

SEC. 3. No person occupying a position below the grade of clerk-copyist shall be promoted to that grade until he shall have been employed two years in the Departmental service and shall have passed, with an average percentage of 70 or over, the examination prescribed by the Commission.

REGULATION III.

SECTION 1. The chief clerk of each Bureau, under the direction of the head thereof, shall keep a record of the efficiency of all employees under his supervision, and a similar record of employees not assigned to any Bureau shall be kept by the Chief Clerk of the Department.

SEC. 2. The record of efficiency shall be kept on such forms as may be prescribed by the Commission after consultation with the Secretary of Agriculture, and shall embrace the elements which are essential to a fair and accurate determination of the relative merits of employees.

SEC. 3. A record of those eligible for promotion shall be kept by the board of promotion review. The board shall have access to efficiency records, and may at any time call for a transcript of the same.

SEC. 4. The efficiency reports made by the chiefs of the several Bureaus, Divisions, and Offices of the Department of Agriculture, respecting the value of the personal services in the Department of each person serving under them, and filed with the Appointment Clerk for the Secretary of Agriculture, shall be the basis of all promotions, demotions, and continuations on the rolls of the Department.

SEC. 5. The following shall be the form of efficiency report to be used in the Department of Agriculture:

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 29, 1908.

EFFICIENCY REPORT.

TO THE CHIEFS OF BUREAUS, DIVISIONS, OFFICES, ETC.:

The chief of each Bureau, independent Division, or Office will report annually, on the 1st day of May, concerning the employees under his supervision as required by the form below, and he is expected to see that the ratings are made after due consideration of all the factors applicable to the individual case. Additional reports may be submitted by chiefs of Bureaus if found necessary.

It should be borne in mind that in determining the relative efficiency of employees, comparison will be made between those of the same grade or doing the same or similar kinds or grades of work. In determining the ratings, the degree of excellence adopted as the standard should not be an impossible one, but one which can be attained by a capable person, and the employee whose work fulfills the requirements of this standard should be given the maximum rating.

The ratings will be indicated by a mark (x) in the appropriate space and by such additional remarks as may be deemed desirable.

JAMES WILSON,
Secretary of Agriculture.

DEPARTMENT OF AGRICULTURE,
May 1, 190—.

Bureau of ....
Name of employee .... Station ....
Official designation .... Salary, $ ....

CHARACTER OF WORK.

Class 1: Administrative, executive, supervisory		Class 2: Scientific, technical, professional	

If the duties of the employee place him in one or both of the preceding classes, indicate the relative degree in which the following requirements are involved:

	High.	Moderate.	Small.
Special ability, knowledge, training, experience			
Exercise of judgment, discrimination, discretion			
Original thought, consideration, investigation			
Responsibility			

Class 3: Clerical		Class 4: Skilled trades	
Class 5: Special occupations		Class 6: Skilled laborers, watchmen, messengers	

If the employee is in one of the four groups last above named, indicate the grade of work.

Largely supervisory, or requiring highest order of ability, involving much original thought, consideration, and investigation	
More or less routine, involving responsibility, special ability, and original thought, consideration, and investigation	
Routine, requiring but little original thought or consideration, but requiring judgment, responsibility, and special skill	
Simple or routine work, requiring care, accuracy, and skill	

If the work performed is that of an unskilled laborer, janitor, charwoman, indicate it here	

Describe the work of the employee under consideration in sufficient detail to enable a reviewing officer to compare it with that of others:

QUALITY OF WORK.

		Degrees of efficiency and relative value of terms.				
		Excellent, 96-100.	Very good, 91-95.	Good, 85-90.	Fair, 70-84.	Poor, under 70.
1 a b	Personality—ability to represent the Bureau creditably in its intercourse with other offices and the public					
2 a	Scientific, technical, professional, or general ability and experience; ability to develop and direct lines of work; ability to obtain, interpret, and present results					
3 a b	Capacity for administrative, executive, or supervisory duties					
4	Capacity to perceive, devise methods, adapt means to ends, adopt suggestions, execute directions					
5	Loyalty; conscientiousness; accuracy and reliability; extent to which the judgment, discernment, or decisions of the employee or the work done can be depended upon; promptness in carrying out instructions or in attending to routine work; willingness to take up new work or to do extra work; appearance of work done					
	Considering all the factors applicable to the work of the employee, indicate the quality of his work viewed as a whole					

[a] To be considered only in connection with classes 1 and 2 under "Character of work."

[b] To be considered only in connection with such of the employees included in classes 1 and 2 as may be occupying positions where the qualities mentioned are important.

REMARKS:

QUANTITY OF WORK.

In rating on quantity of work, consider industry, speed, attentiveness, energy, application, perseverance, amount of mental or manual labor required to produce results, or of time where that is the principal element.

	Terms of measurement and relative value.				
	Very large, 96-100.	Large, 91-95.	Average, 85-90.	Small, 70-84.	Very small, below 70.
Rating					

REMARKS:

ATTENDANCE AND DEPORTMENT.

	Degrees of satisfaction.		
	Very satisfactory.	Satisfactory.	Unsatisfactory.
Attendance: Consider punctuality; whether employee habitually takes excessive amount of sick leave or leave without pay; absence during official hours from desk or place of duty to detriment of work; absence without prior permission or prompt notification with reason therefor; overtime			
Deportment: Consider general demeanor and habits; disregard of or violation of rules and instructions; courtesy in official relations and personal intercourse with coworkers; interference with or annoyance to other employees; insubordination; inattention, negligence, indifference			

If the attendance or deportment has been unsatisfactory, state in what particular; if the employee has been admonished with regard to it, without improvement, so state.

REMARKS:

	Excellent, 96-100.	Very good, 91-95.	Good, 85-90.	Fair, 70-84.	Poor, under 70.
Considering the quality and quantity of work done by this employee, and his record for attendance and deportment, indicate how you would rate the value of his services—that is, his general efficiency	....	....	....	....	....

If you think this employee should be advanced or reduced in grade or salary, state to what grade or salary and give reasons:

Approved.

——— ———, *Chief of Bureau.*

Initials of marking officer ———

SEC. 6. An examination into the relative efficiency of employees, as shown by the efficiency record hereinbefore provided for, and such further tests as the commission may deem necessary, shall constitute an examination for promotion from one class to another class. No person, except as herein provided, shall be eligible for promotion until he shall have passed such an examination.

SEC. 7. Examinations for promotion from one grade to another grade shall be conducted by the board of promotion examiners at such times as may be fixed by the commission.

SEC. 8. Efficiency reports shall be called for by the Appointment Clerk for the Secretary of Agriculture, before the termination of the month of March each year, and may be submitted by chiefs of Bureaus, etc., or called for at such other times as the interests of the Department seem to require.

JOHN A. MCILHENNY,
Acting President United States Civil Service Commission.

Approved July 29, 1908.

JAMES WILSON,
Secretary of Agriculture.

NOT MORE THAN TWO MEMBERS OF A FAMILY ELIGIBLE FOR APPOINTMENT IN THE CLASSIFIED CIVIL SERVICE.

The civil-service act, approved January 16, 1883, provided as follows:

SEC. 9. That whenever there are already two or more members of a family in the public service in the grades covered by this act no other member of such family shall be eligible to appointment to any of said grades. (Civil-service act, approved January 16, 1883.)

N. B.—*Family—Eligibility for examination.*—Whether there are already two or more members of a family in the public service, etc., as provided in section 9 of the civil-service act of January 16, 1883, chapter 27, is not a question to be considered by the Civil Service Commission, but by the appointing power. (Opinion of June 12, 1883, Atty. Gen., Vol. XVII, p. 554.)

Family—Eligibility for appointment.—Where a father and daughter held each an office in the classified service in one of the Departments and another daughter, having passed the required examination, was proposed for appointment in another Department: *Held*, That by force of section 9 of the act of January 16, 1883, chapter 27, the last-mentioned daughter, so long as the above state of facts exists, is ineligible for appointment to any office or place in the classified service. (Opinion of Dec. 9, 1884, Atty. Gen., Vol. XVIII, p. 83.)

Family—Eligibility for examination and certification.—On May 25, 1907, the Attorney-General rendered a decision that where two or more members of a family are in the public service in the grades covered by the civil-service act the Commission is authorized and required to withhold from certification the name of any other member of such family.

The Attorney-General has also decided, under date of July 12, 1907, that the "family" consists of those who live under the same roof with the pater familias—those who form his fireside; but when they branch out and become heads of new establishments they cease to be part of the father's family.

In view of these decisions applications will be accepted from persons who show that other members of their family are in the Government service, but the names of such persons will not be certified so long as two or more members of their family are in the Federal service in the grades covered by the civil-service act.

Where a father and two of his married sons each hold positions in the classified service, but the sons maintained separate homes and lived apart from their father, a daughter living with her father made application for examination: *Held*, That the sons were no longer members of the father's family within the civil-service act, and, accordingly, that but one member of the family was employed in the classified service at the time the daughter made application, and she was therefore eligible for appointment if otherwise qualified under the civil-service act and rules. (Opinion of Attorney-General, July 12, 1907.)

UNITED STATES CIVIL SERVICE COMMISSION,
Washington, D. C., August 29, 1908.

The honorable the SECRETARY OF AGRICULTURE.

SIR: Section 9 of the civil-service act provides as follows:

"That whenever there are already two or more members of a family in the public service in the grades covered by this act no other member of such family shall be eligible to appointment to any of said grades."

There seems to be no doubt that this section applies to reinstatement as well as to original appointment. As the Attorney-General has recently held that the Commission was not authorized to certify an eligible where there were two or more members of the same family in the public service, you are requested to furnish with every application for reinstatement an official statement that the Department has investigated the matter and the person whose reinstatement is sought has not two or more members of his family already in the competitive service.

By direction of the Commission:

Very respectfully, (Signed) HENRY F. GREENE,
Commissioner.

SCIENTISTS IN THE DEPARTMENT SEPTEMBER 15, 1908.

Branch of the Department.	Number.	Branch of the Department.	Number.
Weather Bureau	154	Bureau of Biological Survey	20
Bureau of Animal Industry	1,052	Office of Experiment Stations	100
Bureau of Plant Industry	564	Bureau of Statistics	11
Forest Service	272	Office of Public Roads	43
Bureau of Chemistry	212	Library	15
Bureau of Soils	85		
Bureau of Entomology	79	Total	2,607

REPORT OF THE SOLICITOR.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SOLICITOR,
Washington, D. C., October 1, 1908.

SIR: I submit herewith a report of the work of the Office of the Solicitor for the fiscal year ended June 30, 1908.

Respectfully,

GEO. P. MCCABE,
Solicitor.

Hon. JAMES WILSON,
Secretary of Agriculture.

DUTIES OF THE SOLICITOR.

The duties of the Solicitor, as outlined in your General Order No. 85, of June 17, 1905, were stated fully in the first report of this Office, September 15, 1907, and it is not deemed necessary to restate them. In the fiscal year just closed the amount and importance of the work in each of the six divisions assigned to the Solicitor has largely increased. This increase has been due in large measure to the legal side of the operations of the meat-inspection amendment and of the food and drugs act.

It is not practicable in a report of this nature to present other than a very general outline of the more important work of the Office.

LEGAL ADVICE.

Many and varied legal questions involved in the operations of the Department have arisen during the year, upon which both oral and written opinions and advice were rendered the Secretary and the various chiefs of Bureaus. Scarcely a day intervened without the submission of one or more of these questions. Many of the matters have been of a strictly confidential nature, of which propriety and expediency forbid a statement in this report.

COMMUNICATIONS TO THE DEPARTMENT OF JUSTICE.

TWENTY-EIGHT HOUR LAW.

The fiscal year just closed will probably remain the most conspicuous in the history of enforcement of the twenty-eight hour law, not only because of the large number of cases determined, but also on account of the fundamental questions raised by the railroads and adjudicated by the courts.

A brief statement of the manner of administering the law and reporting the cases was given in the last annual report of the Solicitor, and it is not deemed necessary to repeat it now. With the experience derived from the training of the previous year, the inspectors of the Bureau of Animal Industry were enabled greatly to improve their efficiency during the year just closed, and the number of cases reported by them, together with the improved standard of excellence in their reports of the violations, are testimonials to their activity and proficiency. It is a pleasure to report that the cooperation of the United States attorneys with the Department in its effort to procure observance of the law has been cordial and effective. This Office has maintained close and free communication with the United States attorneys in respect to this law and has furnished them opinions, both in letters and in carefully prepared briefs, when requested or when the exigencies of the cases seemed to demand. This collaboration has been harmonious and productive of splendid and encouraging results.

Among the most important questions connected with the law, adjudicated during the year, was that of the unit of violation, or, in other words, the basis for the imposition of the penalty prescribed by the act. The question was not entirely new, as it had been raised incidentally as long ago as 1883, when in the case of United States *v.* Boston & A. R. Co. (15 Fed., 209), it was held by District Judge Nelson that the statute could not be so construed as to make the unlawful confinement of each animal a separate offense, and thus multiply the penalty by the whole number of animals. It was contended on behalf of the United States that such could be done, but no other basis for computing the penalty was suggested, and the decision left in abeyance any positive rule on the subject. In 1901 the question arose again, in United States *v.* St. Louis & S. F. R. Co. (107 Fed., 870), where the complaint charged a separate offense for each carload of animals contained in a train, the whole shipment, however, having been made by one consignor to one consignee. District Judge Rogers held that there was only one offense. This case has been cited and relied on many times by the attorneys for the railroads to support their contention that the trainload is the unit, but even a casual examination of the decision will disclose that the trainload in this case was composed of a number of cars containing cattle consigned by the same consignor at the same place and at the same time to the same consignee. Hence the court very properly decided that but one offense had been committed. The language of the court will plainly distinguish this case from those based upon a train containing several independent shipments.

It was said:

> It is admitted in argument by the plaintiff, and it inferentially appears so strongly as to make it equivalent to an affirmative allegation, that the separate cars described in each count constituted one and the same train of cars, and it appears that all the cattle were shipped by the same consignor to the same consignee at the same time, and that they arrived at the different places specified in the complaint at the same time. So that it is manifest that the different cars described in the separate paragraphs of the complaint constituted one train, and that the shipment of cattle was one shipment.

It thus appears that the court in this case was of the opinion that the *shipment* was the unit of violation, but as the facts showed but one shipment the carrier could only be compelled to pay one penalty. Rather than an authority in their favor, it is strongly against them. These two cases were brought under the old twenty-eight-hour law, and up to the amended law of 1906 they constituted the only reported adjudicated cases involving this question. The act of June 29, 1906, superseding the old law, contains a provision not found in the old law that sheds some light upon the intent of Congress in reference to this question. It is provided "that upon the request of the owner or person in custody of that particular shipment * * * the time of confinement may be extended to thirty-six hours." When, in 1906, the Department determined to enforce this act with vigor, and many cases were reported to the United States attorneys after the act of 1906 became effective, it was apparent that this question would be one of the first, and perhaps the most vital, to be raised.

In the early correspondence of this Office with the United States attorneys it was urged upon them to insist upon the imposition of a separate penalty for each distinct shipment regardless of the number of shipments in the train. It was thought that in the use of the clause above quoted Congress had evinced its intent to constitute each shipment a separate offense. The railroads, with a degree of unanimity expected, resisted this construction of the act with vigor, contending that the offense consisted in the confinement of the whole number of animals in a train regardless of the number of individuals, cars, or shipments in the train.. The courts have been divided on the question, and no final solution has yet been reached, but the decision of the circuit court of appeals for the sixth circuit, in United States *v.* Baltimore & Ohio Southwestern Railroad Company (159 Fed. Rep., 33), decided February 4, 1908, would seem to indicate what the final decision of the courts will be. That was a suit brought in the southern district of Ohio. The district judge held that the unit of violation was the entire trainload, irrespective of the number of shipments contained therein. From this ruling the United States sued out a writ of error to the circuit court of appeals, as stated above, where the judgment was reversed, the court holding that the unit of violation is the shipment. This construction of the act sustains the position of the Department, and, while it is not strictly final, it is and has been a guide for the district courts in subsequent cases. The railroad has removed the case to the Supreme Court, and it is probable the question will be determined finally in the fall of the present year. Another important question was decided in connection with this case, and one of very vital consequence in the enforcement of the act, namely, that the United States is entitled to a writ of error from an adverse judgment. The railroad contended that the act is so far criminal in its nature that the rule of finality of a judgment was applicable to it, and that there could be no appeal on behalf of the United States.

The railroads have laid considerable stress upon the words "knowingly" and "willfully" in section 3 of the act, contending that in order to establish the offense the United States must show beyond a reasonable doubt that it was committed with criminal knowledge and willfulness. The courts have not evinced a disposition to view these words in the same sense in which they are employed in criminal statutes, and, while there was for a time some uncertainty as to the extent to which the United States would be required to go in the proof of knowledge and willfulness, it seems that the question will not seriously militate against the enforcement of the act.

At the close of the preceding fiscal year there were 653 cases under this law pending in the courts, a considerable number of them having come over from previous years. During the fiscal year just closed 685 cases were transmitted to the Attorney-General for prosecution, as against 677 in the preceding year. There were 109 cases dismissed on account of insufficient evidence. In 401 cases, exclusive of those pending on appeal, penalties were imposed, as against 16 in the preceding year, and 828 cases were pending at the close of the year. The 401 cases in which penalties were assessed resulted in the payment into the Treasury of $68,731.71, of which $61,530 were penalties and $7,201.71 costs.

The table introduced hereafter shows the more important details of the cases resulting in the imposition of penalties. It is proper to add here that those cases in which judgments were rendered for the Government and appeals taken by the defendants are not included in the table.

It will be seen that no pains have been spared to enforce obedience to the act. It must be apparent, also, that the cost of collecting the evidence and preparing the cases for trial has been great. The activity of the inspectors and the necessary preliminary work in procuring the evidence to sustain the suits have been curtailed to a considerable extent by lack of funds. There is satisfaction, however, in the reflection that with what means the Department had at its disposal the maximum results were obtained.

It should not be deduced from what is here stated that violations of the act are on the increase, but rather that the diligence of the Department, accentuated by its better equipment for the work, has disclosed a larger number of offenses than formerly. As a matter of fact, the railroads have at last realized that it is an expensive undertaking to conduct their business in disregard of the law, and many of them have evinced a disposition, coupled in some instances with active preparations, to comply therewith.

The experience of the Department in its effort to enforce compliance with the act disclosed the need of some provision looking to the collection of evidence to sustain the cases reported and for investigations into the condition of pens and yards into which live stock are unloaded and the manner of unloading them. In order to accomplish this much-needed object, the Secretary, on February 1 of the current year, submitted to the Secretary of the Treasury an estimate of appropriation in the sum of $25,000 to cover the necessary expenses of the work. The item was inserted in the agricultural appropriation bill, but was eliminated on the floor of the House by an amendment seemingly designed to accomplish the same purpose. The necessity for an adequate appropriation for the work is as great now as it was when requested. It would seem that little objection could be urged against the proposed appropriation, as the penalties collected under the act during a year greatly exceed it.

During the last session of Congress several bills were introduced having for their object the establishment of an average minimum speed of 16 miles an hour on all roads carrying interstate shipments of live stock. None of these became law during that session. The matter of a minimum speed rate in the transportation of animals has received the attention of a large body of those interested in the production and transportation of domestic animals, as well, also, by the considerable portion of the people who view the matter entirely from a humanitarian standpoint, and it is the consensus of opinion that if a reasonable speed could be enforced it would greatly alleviate the suffering of animals in transit and expedite them to market with the minimum amount of shrinkage.

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during fiscal year from July 1, 1907, to June 30, 1908.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
54	Atchison, Topeka and Santa Fe	Missouri, western district	$100	$20.97
440	do	do	100	106.59
801	do	Illinois, northern district	100	18.21
880	do	do	250	20.01
1314	do	do	100	18.21
1315	do	do	100	18.21
1316	do	do	100	18.21
389 390 391	do	Colorado	300	217.58
374	do	California, southern district	100	79.70
374*a*	do	do	100	
374*b*	do	do	100	
375	do	do	100	
376	do	do	100	
436	do	do	100	
437	do	do	100	
531	do	do	100	
611	do	do	250	76.30
1285	Atlantic Coast Line	North Carolina, eastern district	100	33.00
550	Baltimore and Ohio Southwestern	Ohio, southern district	100	23.57
659	do	do	100	15.70
650	do	do	100	19.82
678	do	do	100	15.65
986	do	do	100	24.60
1016	do	do	100	21.55
1643	Boston and Maine	Massachusetts	100	18.07
691	Chicago, Burlington and Quincy	Missouri, western district	100	19.91
689	do	do	100	19.92
690	do	do	100	19.91
687	do	do	100	19.92
688	do	do	100	19.93
753	do	do	100	19.92
754	do	do	100	19.90
483	do	do	100	19.58
642	do	do	100	19.90
964	do	Illinois, southern district	500	19.73
601	do	Missouri, western district	100	19.58
612	do	do	100	19.51
1189	do	Illinois, northern district	100	18.01
1244	do	do	100	18.61
1422	do	Illinois, southern district	100	99.15
1423	do	do	100	63.08
218	Cleveland, Cincinnati, Chicago and St. Louis.	Ohio, northern district	100	20.56
1212	do	do	100	68.99
1213	do	do	100	
1214	do	do	100	
1215	do	do	100	
1216	do	do	100	
1217	do	Ohio, northern district	100	
1218	do	do	100	
1219	do	do	100	
1220	do	do	100	
1225	do	do	100	
1237	do	do	100	
1238	do	do	100	
1272	do	do	100	
1273	do	do	100	
1274	do	do	100	
1275	do	do	100	
1276	do	do	100	
1277	do	do	100	
1278	do	do	100	
1310	do	do	100	
1311	do	do	100	
667	do	Ohio, southern district	100	35.74
385	Chicago, Milwaukee and St. Paul	Illinois, northern district	150	19.26
624	do	do	100	18.46
723	do	do	100	18.40
725	do	do	100	18.40

Statistical summary of suits under the twenty-eight hour law, etc.—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
674	Chicago, Milwaukee and St. Paul	Illinois, northern district	$300	$20.40
724	do	do	100	18.40
627	do	do	100	18.40
1460	do	Minnesota	100	15.15
1461	do	do	100	
771	Chicago and Northwestern	Illinois, northern district	300	20.86
1005	do	do	100	18.10
1006	do	do	100	18.16
1007	do	do	100	18.10
1008	do	do	100	18.10
1009	do	do	100	18.10
1010	do	do	100	18.10
1011	do	do	100	18.10
1156	do	do	150	18.71
1158	do	do	150	18.65
1159	do	do	200	19.15
1160	do	do	200	19.15
1179	do	do	100	18.21
1180	do	do	100	18.15
1181	do	do	200	19.15
1208	do	do	150	18.51
1221	do	do	150	18.45
1261	do	do	150	19.01
1262	do	do	150	18.95
1266	do	do	150	18.95
1267	do	do	100	18.45
1286	do	do	100	18.45
1287	do	do	100	18.45
1288	do	do	100	18.45
1289	do	do	100	18.45
1290	do	do	250	19.95
9	Chicago, Rock Island and Pacific	Missouri, western district	100	19.69
10	do	do		
11	do	do		
203	do	do	100	20.53
453	do	do	100	19.94
482	do	do	100	19.78
613	do	do	100	19.63
50	do	do	100	19.53
47	do	do	100	19.53
673	do	Illinois, northern district	150	19.66
763	do	do	100	18.81
622	do	do	150	19.25
934	do	do	250	19.56
944	do	do	250	19.50
881	do	do	100	18.00
789	do	do	100	18.00
769	do	do	200	19.00
790	do	do	100	18.00
846	do	do	100	18.00
855	do	do	100	18.00
860	do	do	150	18.50
788	do	do	100	18.00
791	do	do	100	18.00
969	do	do	100	18.00
845	do	do	200	19.00
943	do	do	200	19.00
939	do	do	200	19.00
945	do	do	200	19.00
770	do	do	200	19.00
849	do	do	100	18.00
848	do	do	100	18.00
847	do	do	150	18.50
940	do	do	150	18.50
623	do	do	150	18.50
968	do	do	200	19.00
967	do	do	150	18.50
942	do	do	150	18.50
941	do	do	150	18.50
985	do	do	200	19.00
1092	do	do	100	18.00
1093	do	do	100	18.00
856	do	do	100	18.00
1150	do	do	200	19.00
1146	do	do	200	19.00
1147	do	do	150	18.50
1148	do	do	100	18.00
1140	do	do	100	18.00
1177	do	do	100	18.00
1185	do	do	100	18.45
1178	do	do	200	19.06
1227	do	do	100	18.45
1263	do	do	150	18.95

Statistical summary of suits under the twenty-eight hour law, etc.—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1264	Chicago, Rock Island and Pacific	Illinois, northern district	$100	$18.45
1265	do	do	100	18.45
1173	Chicago, Cincinnati and Louisville	Ohio, southern district	100	....
1174	do	do	100	....
850	Chesapeake and Ohio	do	100	22.66
851	do	do	100	22.66
1089	do	Kentucky, eastern district	100	18.05
1340	do	West Virginia, southern district	200	....
1258	Cincinnati, Hamilton and Dayton	Ohio, southern district	100	15.95
1259	do	do	100	15.95
1518	do	do	100	16.01
1090	do	do	100	16.85
1232	do	do	100	18.21
1233	do	do	100	18.40
686	Cincinnati, New Orleans and Texas Pacific.	Kentucky, eastern district	100	18.35
1255	Detroit, Toledo and Ironton	Ohio, southern district	100	....
267	Great Northern	Minnesota	200	18.12
323	do	Montana	500	34.45
510	do	Washington, western district	400	72.72
682	do	Minnesota	100	18.97
937	do	do	100	18.97
1478	do	do	100	18.87
1480	do	do	100	
535	Grand Trunk	New York, western district	200	16.31
775	do	do	200	16.31
879	do	do	200	16.31
1036	do	do	200	16.31
1062	do	do		
1529	Houston and Texas Central	Texas, northern district	300	....
1143	Illinois Central	Illinois, eastern district	100	38.95
1035	do	Illinois, northern district	100	18.27
1061	do	do	100	18.27
1157	do	do	150	18.62
1182	do	do	150	18.62
1183	do	do	150	18.50
1222	do	do	150	18.57
1243	do	do	100	18.51
1245	do	do	100	18.51
1260	do	do	100	18.51
1270	do	Illinois, eastern district	100	9.89
1271	do	do	100	9.89
1344	Kansas City Southern	Missouri, western district	100	27.84
419	Lake Shore and Michigan Southern	New York, western district	200	16.31
302	do	do	200	16.31
423	do	do	200	16.31
578	do	do	200	16.31
1015	do	do	200	16.31
1030	Louisville and Nashville	Kentucky, western district	100	22.30
1137	do	do	100	22.30
1224	do	do	100	24.30
1256	do	do	100	22.30
1409	Missouri Pacific	Missouri, western district	450	....
1410	do	do		
977	Missouri, Kansas and Texas	Kansas	250	20.75
479	New York, Chicago and St. Louis	New York, western district	200	16.31
452	do	do	200	16.31
525	Northern Pacific	Washington, eastern district	500	39.66
528	do	do	500	19.45
1515	do	Minnesota	100	18.77
1516	do	do	100	
1514	do	do	100	
1486	do	do	100	
1483	do	do	100	
1484	do	do	100	
526	do	Washington, eastern district	1,000	31.02
527	do	do		
452½	do	do		
1397	do	do	500	180.78
1393	do	do	500	
1394	do	do	500	
1395	do	do	500	
1396	do	do	500	
1398	do	do	500	
654	do	North Dakota	100	35.10
685	do	do	100	50.34
942	Oregon R. R. and Navigation Company	Washington, eastern district	250	18.96
545	San Pedro, Los Angeles and Salt Lake	California, southern district	125	38.44
547	do	do	125	
531	do	do	500	
436	Southern Pacific	do	125	40.00
437	do	do	125	

Statistical summary of suits under the twenty-eight hour law, etc.—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
809	Southern Pacific	California, southern district	$250	$34.60
830	do	Oregon	250	35.52
194	do	California, northern district	200	....
195	do	do	200	....
196	do	do	200	....
220	do	do	200	....
278	do	do	200	....
420	do	do	200	....
426	do	do	200	....
744	St. Louis and San Francisco	Missouri, western district	150	12.20
748	do	do	150	12.25
749	do	do	150	11.55
751	do	do	150	12.45
819	do	do	150	12.00
822	do	do	150	10.55
825	do	do	150	10.30
821 837	do	do	150	20.35
838	do	do	150	10.55
948	do	do	150	10.70
1069 1048	do	do	150	20.35
1071 1072	do	do	150	20.20
1045 1046	do	do	150	20.50
1053	do	do	150	10.55
1050 1052	do	do	150	20.20
1049 1051	do	do	150	20.20
1103 1114	do	do	150	20.20
1138	do	do	150	10.55
1139	do	do	150	10.55
1097	do	do	150	10.55
1209	do	do	150	10.55
1253	do	do	150	9.10
1342	do	do	150	9.40
1268	do	do	150	9.40
1299	do	do	150	9.25
1300	do	do	150	9.25
1068	do	Illinois, eastern district	100	....
1372	do	do	100	....
897	St. Louis Merchants' Bridge Terminal	do	100	223.23
1067	do	do	125	
1116	do	do	150	
1117	do	do	175	
843	do	Missouri, eastern district	150	20.47
1450	do	Illinois, eastern district	100	24.77
1352	do	do	110	
1380	do	do	120	
1549	do	do	300	15.75
1550	do	do	325	
543	St. Louis, Iron Mountain and Southern	do	100	24.30
826	do	Arkansas, eastern district	300	....
1057	do	do	300	....
1161	do	do	300	....
1407	do	do	100	38.19
1590	do	do	100	88.92
362	Southern Railway	North Carolina, western district	100	17.45
922	Terminal Railroad Association of St. Louis.	Illinois, eastern district	100	502.14
913	do	do	125	
1118	do	do	150	
1098	do	do	175	
1099 1100	do	do	200	
1101	do	do	225	
1102	do	do	250	
1112	do	do	275	
1123	do	do	300	
1124	do	do	325	
1125 1126 1127	do	do	375	
1128	do	do	450	
1129	do	do	500	
997	do	do	100	228.31
998 999	do	do	125	
1000	do	do	150	
1003	do	do	175	
1004	do	do	200	

Statistical summary of suits under the twenty-eight hour law, etc.—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1012	Terminal Railroad Association of St. Louis.	Illinois, eastern district	$100	$294.30
1013	do	do	125	
1014	do	do	150	
952	do	do	175	
1068	do	do	200	
543	do	do	225	
1065	do	do	250	
1066				
1073				
1075				
956	do	do	100	250.53
957	do	do	125	
958	do	do	150	
959	do	do	175	
960	do	do	200	
961				
962				
963				
1140	do	do	100	265.55
1142				
1144				
395	do	do	125	
1134	do	do	150	
1135	do	do	175	
1136	do	do	200	
1021	do	do	225	
1133				
1001	do	do	100	34.54
1166	do	do	125	106.97
1164	do	do	150	
1165	do	do	175	
1170	do	do	200	
1200	do	do	100	
1246	do	do	100	198.04
1247	do	do	125	
1248	do	do	150	
1250	do	do	175	
1252	do	do	200	
1319	do	do	225	
1320	do	do	250	
1321	do	do	275	
1322	do	do	300	
1324	do	do	325	
1343	do	do	375	
823	do	Missouri, eastern district	100	21.37
824	do	do	100	
1543	do	Illinois, eastern district	100	15.95
1544	do	do	110	
1545	do	do	120	
1546	do	do	130	
1547	do	do	140	
1348	do	do	100	17.90
1349	do	do	110	
1309	do	do	120	
1370	do	do	130	
1372	do	do	140	
1374	do	do	150	
1375	do	do	160	
1376	do	do	170	
1377	do	do	180	
1408	do	do	190	
1411	do	do	200	
1412				
1413				
1414	do	do	210	
1415				
1419	do	do	220	
1421	do	do	230	
1439	do	do	240	
1442	do	do	250	
1443	do	do	260	
1448	do	do	270	
1449	do	do	280	
1451	do	do	290	
1454	do	do	300	
1455	do	do	310	
1456	do	do	320	
1457	do	do	330	
1458	do	do	340	
1567	do	do	300	26.84
1568	do	do	325	
1573	do	do	350	
1579	do	do	300	15.35
1418	Wabash	do	100	17.61

401 cases; penalties recovered, $61,530, costs recovered, $6,628.53.

LACEY ACT.

During the year seven cases involving offenses under the act of Congress of May 25, 1900, commonly known as the Lacey Act, prohibiting interstate commerce in game killed in violation of local laws and requiring packages containing game shipped in interstate commerce to be plainly marked so that the nature of the contents and name of shipper can be readily determined by inspection of the outside thereof, were reported to the Attorney-General for prosecution. In addition to these, four cases involving the unlawful killing of elk in the Yellowstone National Park were similarly reported. The status and disposition of four of these cases and of cases coming over from the previous year are shown in the table below.

Two of the defendants, William Binkley and Charles Purdy, were convicted and punished during the previous fiscal year for shipment of heads, hides, and horns of elk killed in violation of local laws. It having been ascertained that some of their material was taken in the Yellowstone National Park, proceedings were instituted at once for their punishment for this offense.

The act in its present form having proved to be ineffective to accomplish some of the objects for which it was designed, the Secretary during the year submitted a recommendation to the Committee on Codification of the Penal Laws of the House of Representatives looking to the amendement of the act. Should the suggestion be adopted and incorporated in the codification, the Department will be enabled to accomplish the beneficial results sought by the original act.

Cases under the Lacey Act and Yellowstone National Park Act coming over from previous year and reported to Department of Justice during fiscal year from July 1, 1907, to June 30, 1908.

Case No.	Defendant.	Judicial district.	Offense charged.	Disposition or present status of case.
88	Wm. Binkley	Wyoming	Killing of elk in Yellowstone National Park.	Sentenced to jail six months.
88a	Chas. Purdy	do	do	Do.
91	Escanaba Fish Co.	Michigan	Shipment of deer killed in violation of local laws and marked "barrel of fish."	Fined $25; paid.
92	Fred Olin	Wisconsin	Shipment of deer killed in violation of local laws and marked "hides."	Fined $100; paid.
93	Proudfit & Ormsby.	Colorado	Shipment of prairie chickens as "dressed poultry."	Pending.
94	Northern Produce Co.	Texas	Shipment of wild ducks as "dressed poultry."	Do.
113	Chas. Isobel	Wyoming	Killing of elk in Yellowstone National Park.	Indicted Nov., 1907; not apprehended.
113a	Oscar Adams	do	do	Do.
124	Guy Miller Produce Co.	Oklahoma, western district.	Shipment of quail in unmarked package.	Indicted; plea not guilty; case set for trial January term, 1909.
125	Rabito-Battistella Fish and Oyster Co.	Louisiana	Shipment of wild ducks in unmarked package.	Pending.

ALASKA GAME LAW.

During the year the Department transmitted to the Attorney-General for prosecution a case involving the unlawful shipment of moose horns from Alaska to Washington. These trophies were exported from Alaska without permit from the Secretary of Agriculture, in violation of section 5 of the act of June 7, 1902. The matter was unsettled at the expiration of the year.

CONVERSION OF PROPERTY OF THE DEPARTMENT.

During the year four cases of conversion of property of the Department were submitted to this Office for action after unsuccessful efforts of the chiefs of the Bureaus to effect its return. Three of these involved the unlawful retention by former employees of the Weather Bureau of valuable instruments intrusted to them in connection with their official duties. These cases were reported to the Attorney-General. One of them was closed by return of the property, and the other two were unsettled at the expiration of the year. In the fourth case, involving the stubborn retention by the offender of valuable lantern slides of the Office of Experiment Stations, the Solicitor made direct demand upon the delinquent for the property and after some trifling delay recovered it.

CASES IN THE COURT OF CLAIMS.

At the close of the last fiscal year there were pending in the Court of Claims four cases based upon transactions arising in the Department. These were specifically stated in the last report of this Office. During the year just closed two of these, Lord & Hulett *v.* The United States, and New York Market Gardeners' Association *v.* The United States, were finally determined, the petition in the former having been dismissed March 9, 1908, and the latter having resulted in a judgment of January 6, 1908, for the petitioner. The other two cases, Crary, Packer & Knott *v.* The United States, and Thos. H. Reeves *v.* The United States, are still pending. To the former case considerable attention was directed by the Office during the year, in the preparation of a brief covering the law applicable to the case and a request for findings of fact in behalf of the United States. This work was done at the request of, and in cooperation with, the Assistant Attorney-General handling the case.

FALSIFICATION OF ACCOUNTS.

In January, 1908, John C. Leeper, a former employee of the Bureau of Animal Industry, stationed in Wyoming, was convicted, upon evidence submitted to the Attorney-General by this Office during the last fiscal year, of inserting certain false and fraudulent items in his expense account with the Department, and was fined $1,000 and committed to jail for thirty days. It would seem that if common honesty can not be relied upon to deter the fraudulently inclined, the severity of the law, as exemplified in this case, should intervene to check these practices.

SUPPRESSION OF CONTAGIOUS DISEASES OF DOMESTIC ANIMALS.

Eight cases involving violations of the act of May 29, 1884, "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," were reported to the Attorney-General during the year, an increase of seven over the year previous.

In addition to these there were two cases, Nos. 74 and 90, which remained unsettled at the expiration of the last year.

The appended table shows the nature of the offenses charged and the disposition or present status of these cases:

Cases under the act of May 29, 1884, for the suppression of contagious diseases of animals, reported, pending, or finally settled during the fiscal year from July 1, 1907, to June 30, 1908.

Case No.	Defendant.	Judicial district.	Offense charged.	Disposition or present status of case.
74	J. K. Smith.......	Kentucky, eastern district.	Shipment of 220 lambs infected with scabies from Kentucky to Ohio.	Mistrial, Oct. 19, 1906; continued; pending.
90	Richards & Roberts.	Wisconsin, western district.	Shipment of 108 sheep infected with scabies from Wisconsin to Illinois.	Pending.
110	David May.......	Kentucky, eastern district.	Shipment of 106 lambs infected with scabies from Kentucky to Ohio.	Reported to Attorney-General Oct. 22, 1907.
111	H. J. Benson......	Iowa, northern district.	Shipment of 611 sheep infected with scabies from Iowa to Illinois.	Do.
112	John Hunolt......	Missouri, eastern district.	Shipment of 153 sheep infected with scabies from Missouri to Illinois.	Reported to Attorney-General Oct. 28, 1907.
119	Richards & Roberts.	Wisconsin, western district.	Shipment in 9 separate consignments of 1,220 sheep infected with scabies from Wisconsin to Illinois.	Reported to Attorney-General Dec. 18, 1907.
121	S. W. Beal........	Michigan, eastern district.	Shipment of 133 sheep infected with scabies from Michigan to New York.	Prosecution suspended upon further investigation disclosing absence of intent to violate the act.
141	B. Waldron.......	Indiana...........	Shipment of 218 sheep infected with scabies from Indiana to New York.	Reported to Attorney-General Mar. 30, 1908.
142	H. J. Benson......	Iowa, northern district.	Shipment of 109 sheep infected with scabies from Iowa to Illinois.	Reported to Attorney-General Mar. 31, 1908.
143	H. S. Boomgaarden.	.....do............	Shipment of 503 sheep infected with scabies from Iowa to Illinois.	Grand jury refused to indict; case dropped.

QUARANTINE LAW AND REGULATIONS.

PROSECUTIONS AGAINST INDIVIDUALS.

Six cases involving violations by individuals of the act of March 3, 1905, "An act to enable the Secretary of Agriculture to establish and maintain quarantine districts, to permit and regulate the movement of cattle and other live stock therefrom, and for other purposes," and the regulations made thereunder, were reported to the Attorney-General during the year, an increase of three over the previous year. In addition to these, six cases were pending at the close of the last year and were either settled during the present year or were pending at its close. Five of these cases resulted in convictions, and in the imposition of a fine of $100 and costs in four and a suspension of sentence upon payment of costs in the other. The small number of the above cases must be taken as an indication of the successful working of the law and regulations as well as the activity of the Bureau of Animal Industry and its employees.

The appended table shows the character of these offenses and the disposition or present status of the cases:

Cases against individuals under quarantine act of March 3, 1905, pending, reported, or finally settled during the fiscal year from July 1, 1907, to June 30, 1908.

Case No.	Defendant.	Judicial district.	Offense charged.	Disposition or present status of case.
48	John Fort	North Dakota	Movement of stock not dipped or inspected from quarantined area in South Dakota to North Dakota.	Plead guilty; fined $100 and costs.
48	Eugene Fort	do	do	Do.
48a	Wm. Perkins	do	do	Do.
50	E. E. Coffey	Oklahoma	Movement of 91 cattle from quarantined area in Oklahoma to Texas.	Acquitted.
77	John Oleson	Idaho	Movement of 4,500 sheep from Idaho to Oregon without permit and inspection.	Pending.
82	James Casper	Oklahoma	Movement of 122 cattle not dipped or inspected from quarantined to open area in the Territory.	Do.
95	J. M. Miller	North Carolina, western district.	Movement of 1 cow, not dipped or inspected, from South Carolina to North Carolina.	Convicted; sentence suspended on payment of costs.
109	Walter Johnson	Tennessee, eastern district.	Driving 5 cattle from Polk County, Tenn., to North Carolina.	Mistrial in May, 1908; retrial set for fall term.
117	E. B. Johnson	Oklahoma, western district.	Driving 120 cattle from Indian Territory to Oklahoma.	Convicted; fined $100 and costs. June 26, 1908.
122	J. F. Ravenscroft and John A. Edwards.	do	Driving 297 uninspected cattle from Oklahoma to Kansas.	Reported to Attorney-General Jan. 17, 1908.
150	James Marler and J. H. Ballantyne.	Idaho	Driving 1.800 uninspected sheep from Oregon to Idaho.	Reported to Attorney-General Apr. 3, 1908.
159	John Zane and Elmer Edwards.	Oklahoma, eastern district.	Driving 1 infected cow from Indian Territory to Missouri.	Reported to Attorney General Apr. 24, 1908.
160	L. D. Hoy	Oregon	Driving 80 sheep from Washington to Oregon without complying with regulations.	Reported to Attorney-General Apr. 25, 1908.

PROSECUTIONS AGAINST RAILROADS.

During the preceding fiscal year reports of 109 violations by railroads of Regulation 14 (d) of the "Regulations of the Secretary of Agriculture governing the inspection, disinfection, certification, treatment, handling, and method and manner of delivery and shipment of live stock which is the subject of interstate commerce" were made to this Office. As the regulations had been in force only a short time, it was thought best not to institute prosecutions, but to allow the railroads sufficient time in which to adjust themselves for compliance with the regulations. With this in view, letters were written to the general counsel of all the roads calling attention to the reports and requesting instructions to officers and agents to see that the offenses did not recur. To these letters seemingly encouraging replies were received, and it was hoped the regulations would be obeyed without resort to prosecutions. Instead, however, reports of violations continued to come in, and 33 cases were reported to the Attorney-General during the year. They were all based upon the failure of the railroads to properly placard their cars in which "southern cattle" were conveyed from one State to another. Twenty-five of these cases, shown in the appended table, were tried during the year and all resulted in the imposition of fines and costs.

Cases against carriers under the act of March 3, 1905, and regulations of the Secretary of Agriculture for its enforcement, reported and finally settled during the fiscal year from July 1, 1907, to June 30, 1908.

Case No.	Defendant.	Judicial district.	Fine.	Costs.
500a	St. Louis, Iron Mountain and Southern Ry	Missouri, eastern district	$100	$30.44
504a	do	do	100	
505a	do	do	100	
506a	do	do	100	
507a	do	do	100	
508a	Illinois Central R. R	Illinois, eastern district	100	42.16
509a	do	do	100	
510a	do	do	100	
511a	do	do	100	
512a	do	do	100	
514a	Mobile and Ohio R. R	do	100	......
515a	Illinois Central R. R	do	100	(*)
516a	do	do	100	
517a	St. Louis, Iron Mountain and Southern Ry	Missouri, eastern district	100	(†)
518a	do	do	100	
519a	do	do	100	
520a	do	do	100	
521a	do	do	100	
522a	do	do	100	
524a	do	do	100	
523a	do	do	100	23.80
525a	do	do	100	
526a	Illinois Central R. R	Illinois, eastern district	100	27.43
527a	do	do	100	
528a	Mobile and Ohio R. R	do	100	......

Total fines, $2,400; total costs, $123.83.

* Included in cases 508*a* to 512*a*. † Included in cases 500*a* to 507*a*.

INTERFERENCE WITH EMPLOYEES OF THE BUREAU OF ANIMAL INDUSTRY IN THE PERFORMANCE OF THEIR DUTIES.

The orderly operations of the Department during the latter part of the previous year and early part of the year just closed were somewhat marred by several instances of more or less serious and obstructive tendencies, but the prompt and vigorous action taken in the matters promise well for the future. On the first day of the fiscal year this Office prepared for submission by the Secretary to the Attorney-General a statement of the facts and testimony adducible in the most serious case of this nature that has yet occurred. The facts were, briefly, as follows: Daniel Donoahue, owner of a ranch in Wyoming, desiring to ship a number of cattle from the State, demanded of Conrad Shafer, an employee of the Bureau of Animal Industry charged with the duty of inspecting cattle intended for interstate commerce, a certificate reciting that certain cattle intended to be so shipped by Donoahue had been dipped as required by the regulations of the Department. As the cattle had not been dipped, Shafer refused to issue the certificate, which enraged Donoahue to such a degree that he assaulted Shafer with a dipping fork made of heavy iron fastened to a hoe handle, and inflicted upon him several severe blows about the head, producing a state of unconsciousness. Donoahue was duly indicted, and in November, 1907, tried and convicted under section 5 of the act of March 3, 1905, and sentenced to pay a fine of $500 and to serve three months in jail.

One of the agents of the Department engaged in the work of eradicating the cattle-fever tick in Tennessee, while in the performance of his duties, was assaulted by a man and his wife. The facts were reported to the United States attorney for the middle district of

Tennessee, who submitted the case to the grand jury and secured an indictment. The parties were duly tried and convicted and sentenced to pay a fine of $150.

In another case of assault upon a similar agent of the Department in Tennessee the facts were reported to the United States attorney for the middle district of that State, and after considerable correspondence between him and this Office, it was decided to submit the case, under the peculiar circumstances surrounding it, to the courts of the State. No report of the result was available at the close of the year.

One of the Department's meat inspectors stationed at a meat-packing establishment in Kansas was assaulted during the early part of the year by the foreman of the factory and bruised to a painful extent. The facts were promptly reported to the United States attorney, and indictment under section 5 of the act of March 3, 1905, returned March 10, 1908. The case was set for trial at the September term of court.

Another meat inspector on duty at Logansport, Ind., was similarly assaulted by employees of a packing house. The offenders were indicted under the same act, plead guilty, and on May 20, 1908, were fined $100 each.

The Department was advised during the early part of the year that one of the United States commissioners in Tennessee, by his public utterances and conduct in contempt of the efforts of the Bureau of Animal Industry to extirpate the cattle-fever ticks in that State, was greatly hindering the Bureau in the work, and lending encouragement to that element of the residents of the State opposed to the slight inconveniences necessarily imposed upon them by the Bureau operations. The matter was reported to the Attorney-General for investigation, and as a result formal charges were presented to the district judge asking for the removal of the commissioner from office. The matter is pending awaiting the answer of the commissioner. Some delay was occasioned by the death of the district judge to whom the charges were originally preferred.

FORGERY OF PERMIT FOR SHIPMENT OF CATTLE.

During the year information reached the Department that an agent of one of the railroads in the West, in collusion with certain shippers of diseased cattle, had sent a telegram purporting to be a permit for the movement of the cattle to which the name of one of the inspectors of the Bureau of Animal Industry had been attached. Investigation disclosed that the telegram was a forgery, and the facts were reported to the Attorney-General for action. The matter was in the hands of the United States attorney at the close of the year.

MEAT INSPECTION.

At the close of the preceding fiscal year one case involving a violation of the meat-inspection amendment of June 30, 1906, had been transmitted to the Attorney-General, but had not then been closed. During the present year 24 cases were prepared and submitted to the Attorney-General, one resulting in a conviction and imposition of a fine of $100 and two in disagreement of the juries. The case coming over from the previous year also resulted in the imposition of a fine of $100.

The character of these offenses and the disposition or present status of the cases is shown in the appended table:

Cases under meat-inspection amendment of June 30, 1906, pending, reported, and finally settled during the fiscal year from July 1, 1907, to June 30, 1908.

Case No.	Defendant.	Judicial district.	Offense charged.	Disposition or present status of case.
97	Swift & Co.	Minnesota	Shipment of uninspected lard from Minnesota to Wisconsin.	Convicted; fined $100.
104	A. C. Hunt & Co.	Massachusetts	Shipment of uninspected veal from Massachusetts to Connecticut.	Reported to Attorney-General Aug. 23, 1907.
105	Barry Provision Co.	Illinois, southern district.	Shipment of unwholesome meat of a drowned calf from Illinois to Connecticut.	Plead guilty; fined $100 and costs.
129	E. Ellis	New York, southern district.	Shipment in three consignments of uninspected calves from New York through New Jersey to New York City.	Indicted; tried; jury disagreed; continued.
130	G. A. Dodge	Pennsylvania, middle district.	Shipment of 1 immature calf from Pennsylvania to New York.	Reported to Attorney-General Mar. 12, 1908.
131	H. Kleiman	New York, southern district.	Shipment of 2 uninspected calves from New York through New Jersey to New York City.	Reported to Attorney-General Mar. 14, 1908.
132	John Utter	Pennsylvania, middle district.	Shipment of 1 immature calf from Pennsylvania to New York.	Reported to Attorney-General Mar. 16, 1908.
133	E. B. Wheaton	do	Shipment of 2 immature calves from Pennsylvania to New York.	Do.
134	J. D. Schultz	New York, southern district.	Shipment of 14 immature calves from New York, through New Jersey, to New York City.	Indicted; tried; jury disagreed; continued.
135	Frank Scott	New York, northern district.	Shipment of 9 immature calves from New York to New Jersey.	Indicted June, 1908; case set for trial in October.
136	W. J. Drake	do	Shipment of 6 immature calves from New York to New Jersey.	Do.
137	John Davis	do	Shipment of 14 immature calves from New York to New Jersey.	Do.
138	John Cooper	New York, southern district.	Shipment of 1 immature calf from New York, through New Jersey, to New York City.	Reported to Attorney-General Mar. 24, 1908.
139	E. Ellis	do	do	Do.
140	E. Forshee	do	Shipment of 5 immature calves from New York, through New Jersey, to New York City.	Do.
149	J. Biliecki	do	Transportation of uninspected and unwholesome beef tongues from New York to New Jersey.	Reported to Attorney-General Apr. 6, 1908.
151	A. Babiak	New Jersey	Shipment of uninspected sausages from New York to New Jersey.	Do.
154	P. Marchetto	New York, southern district.	Transportation of uninspected beef from New York to New Jersey.	Reported to Attorney-General Apr. 25, 1908.
155	S. Block	do	Transportation of uninspected pork from New York to New Jersey.	Do.
156	J. Grasser	do	Transportation of uninspected meats from New York to New Jersey.	Do.
157	Samuel Nagel	do	Transportation of uninspected calves' livers from New York to New Jersey.	Reported to Attorney-General May 6, 1908.
158	E. S. Alpaugh	do	Transportation of uninspected veal from New York to New Jersey.	Reported to Attorney-General Apr. 27, 1908.
162	Nick Peters	Iowa, southern district.	Shipment of uninspected meat from Iowa to Illinois.	Reported to Attorney-General May 2, 1908.
163	Henry Muhs	New Jersey	Shipment of sausages from New Jersey to New York from establishment from which inspection had been withdrawn.	Reported to Attorney-General May 12, 1908.
164	W. Kuehnappele	New York, southern district.	Shipment of uninspected meat from New York to New Jersey.	Reported to Attorney-General May 16, 1908.

FOOD AND DRUGS ACT.

At the close of the previous year no cases under the food and drugs act of June 30, 1906, had been reported to the Attorney-General for prosecution, the time intervening between the date upon which the act went into force and the close of the year having been devoted by the Bureau of Chemistry and the Board of Food and Drug Inspection to preliminary work incident to preparations for the proper administration and enforcement of the act. During the year just closed, however, special attention was directed to the cases arising under this act, and 135 cases were reported through this Office to the Attorney-General or to the United States attorneys for prosecution.

A brief outline of the procedure in these cases may be introduced here with propriety. Samples of foods and drugs are purchased in the open market by the several inspectors of the Bureau of Chemistry. These are immediately sent to the Bureau in Washington or to its branch laboratories at important centers of traffic throughout the United States. Here they are analyzed or examined, and if adulteration or misbranding is present the dealer from whom the sample was purchased is cited to a hearing either in Washington or at one of the laboratories most convenient to him. Though not required by the act, the Department usually cites the manufacturers or shippers, also affording them equal opportunity with the dealers to produce evidence. The hearings are reduced to writing, and the whole case is then considered by the Board of Food and Drug Inspection, and if two of the members concur in the opinion that the analytical evidence warrants a prosecution, and this opinion is approved by the Secretary, it is transmitted to the Solicitor for examination as to sufficiency of evidence to establish an offense under other provisions of the act. If the evidence of interstate shipment in those cases embraced within this principle of the act is sufficient, the Solicitor prepares the case for transmission by the Secretary to the Attorney-General. This is the procedure in all that class of cases whereon is based a criminal prosecution. The cases for seizure and condemnation pursue a somewhat different course. In the nature of the case, prompt action is required in these cases. No hearings are required by the act or usually accorded. The inspectors report the presence in interstate commerce of adulterated or misbranded foods or drugs. The chief inspector reports the facts to the Board of Food and Drug Inspection, who in turn reports the matter to the Secretary for approval. The Solicitor then usually prepares a telegram, to be signed by the Secretary, to the proper United States attorney. The larger part of subsequent correspondence in both criminal and condemnation cases is conducted directly by the Solicitor with the United States attorneys.

Of the 135 cases above mentioned, 97 were reported for criminal prosecution, under sections 1 and 2 of the act, and 38 for seizure and condemnation, under section 10. Of the 97 criminal cases, 14 resulted in judgments of conviction, 9 were abandoned for various causes, among them the death of certain offenders and inability to maintain the prosecution because of changed conditions, and in the remaining cases informations had been filed or were under consideration at the close of the year. Of the 38 cases reported for seizure and condemnation of goods, 14 resulted in decrees of forfeiture and condemnation, 5 were abandoned for sundry reasons, among them administrative policy and failure to locate the goods, and in the remainder libels had been filed and seizures effected just before the close of the year. None of the 135 cases has resulted adversely to the Government.

The appended tables, separated because of difference in character of the two classes of cases, show those cases in which some definite action, subsequent to report to the Attorney-General or the United States attorneys, was taken during the year. The character of the offenses and disposition or present status of the cases are shown in the last two columns.

CRIMINAL.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution and finally determined or pending in the courts at the close of the fiscal year from July 1, 1907, to June 30, 1908.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
1	Geo. Liss & Co....	New York, southern district.	Shipment from New York to New Jersey of adulterated and misbranded vanilla extract.	Dropped.
2	.....do............	.....do............	Shipment from New York to New Jersey of adulterated and misbranded lemon extract.	Do.
3	Robert N. Harper.	District of Columbia.	Manufacture and sale in District of Columbia of a misbranded drug.	Convicted; fined $700, pending on appeal.
5	James M. Holloway.	.....do............	Sale in the District of Columbia of renovated butter as Elgin creamery butter.	Dropped.
6	Clark, Coggin & Johnson Co.	Massachusetts.....	Shipment from Massachusetts to the District of Columbia of misbranded coffee.	Information filed and case pending for trial at fall term, 1908.
7	S. W. Noggle Manufacturing Co.	Missouri, western district.	Shipment from Missouri to Kansas of misbranded lemon extract.	Dropped.
8	The Birkett Mills.	New York, western district.	Shipment from New York to Nebraska of misbranded gluten flour.	Plead guilty; sentence suspended.
9	Theo. R. Beardsley's Sons.	New York, southern district.	Shipment from New York to Massachusetts of misbranded flour.	Dropped; defendant died before action could be taken.
10	Digesto Manufacturing Co.	.....do............	Shipment from New York to Massachusetts of misbranded coffee.	Dropped; defendant's goods forfeited in seizure proceedings.
11	Raimes & Co......	.....do............	Shipment from New York to New Jersey of adulterated and misbranded vanilla extract.	Dropped.
13	F. Rogeson & Co..	District of Columbia.	Sale in the District of Columbia of misbranded eggs.	Plead guilty; fined $75.
14	Golden & Co......	.....do............	.....do........................	Do.
24	F. Menown Manufacturing Co	Missouri, western district.	Shipment of misbranded lemon extract from Missouri to Kansas	Information filed; defendant plead not guilty, case set for trial November term, 1908.
25	E. J. Gillies & Co..	New York, southern district.	Shipment of misbranded lemon extract from New York to North Carolina	Information filed, case set for trial September term, 1908.
26	Western Reserve Syrup Co.	Ohio, northern district.	Shipment of misbranded maple sirup from Ohio to Michigan.	Information filed May 29, 1908, and defendant plead not guilty June 29, 1908; case set for trial October term, 1908.
29	Paddock Coffee and Spice Co.	Missouri, western district.	Shipment of adulterated and misbranded vanilla extract from Missouri to Kansas.	Information filed; case set for trial November term, 1908.

Cases under the food and drugs act of June 30, 1906, etc.—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
30	C. B. Woodworth Sons Co.	New York, western district.	Shipment of adulterated and misbranded vanilla extract from New York to Ohio.	Defendant plead guilty and fined $100.
32	Heekin Spice Co..	Ohio, southern district.	Shipment of adulterated and misbranded vanilla extract from Ohio to Kentucky	Defendant plead guilty; fined $5 and costs.
33	Daniel Strason....	Illinois, southern district.	Shipment of adulterated milk from Illinois to Missouri.	Defendant plead guilty; fined $100 and costs, $38.48.
34	.....do..........	.....do..........	.....do..........	Defendant plead guilty; sentence suspended.
35	Jacob Schuepbach.	.....do..........	.....do..........	Information filed June 1, 1908.
38	Mike Benke.......	.....do..........	.....do..........	Do.
39	Henry Beard.....	.....do..........	.....do..........	Do.
40	Union Dairy Co...	.....do..........	.....do..........	Do.
44	Henry Beard.....	.....do..........	.....do..........	Do.
45	William Garnet...	.....do..........	.....do..........	Do.
46	Henry Taake.....	.....do..........	.....do..........	Do.
47	William Welchlen.	.....do..........	.....do..........	Do.
48	Charles Goetz.....	.....do..........	.....do..........	Do.
49	Robert Burns.....	.....do..........	.....do..........	Do.
50	George Schenck...	.....do..........	.....do..........	Do.
51	E. Bleisch........	.....do..........	.....do..........	Do.
52	Chas. Schultz.....	.....do..........	.....do..........	Do.
53	Jacob Bleisch.....	.....do..........	.....do..........	Do.
54	.....do..........	.....do..........	.....do..........	Do.
55	August Schultze..	.....do..........	.....do..........	Do.
56	Ben Schultze......	.....do..........	.....do..........	Do.
59	William Garnet...	.....do..........	.....do..........	Do.
60	C. Taylor.........	.....do..........	.....do..........	Do.
61	George Wittman..	.....do..........	.....do..........	Do.
63	H. Sprehe........	Illinois, eastern district.	.....do..........	Offender dead.
71	George Schwehr...	Illinois, southern district.	.....do..........	Information filed June 1, 1908.
72	Adam Schmitt....	.....do..........	.....do..........	Do.
73	C. Deterding......	.....do..........	.....do..........	Plead guilty; fined $100 and costs, $31.95.
75	T. J. Virgin.......	.....do..........	.....do..........	Information filed June 1, 1908.
76	E. Franklin.......	.....do..........	.....do..........	Do.
79	Ed. Garde........	.....do..........	.....do..........	Do.
80	Henry Brandemeyer.	.....do..........	.....do..........	Do.
81	C. W. Kingery....	.....do..........	.....do..........	Do.
82	H. Bentel.........	.....do..........	.....do..........	Do.
84	J. Roach Abell....	District of Columbia.	Sale in the District of Columbia of cocaine hydrochloride in unlabeled package.	Plead guilty; fined $100.
111	Hancock Liquid Sulphur Co.	Maryland.........	Shipment of misbranded drug from Maryland to the District of Columbia.	Defendant plead guilty; fined $100.
116	Globe Pharmaceutical Co.	Ohio, southern district.	Shipment of misbranded drug from Ohio to the District of Columbia.	Defendant plead guilty, and each of the 2 partners fined $10.
120	Interstate Chemical Co.	Maryland.........	Shipment of adulterated and misbranded pepper from Maryland to North Carolina.	Defendant plead guilty, and fined $25.
123	H. W. Leopoldt...	Oklahoma, western district.	Manufacture and sale in the Territory of Oklahoma of an adulterated and misbranded lemon extract.	Case withdrawn; no prosecution maintainable since statehood.
128	Steinbock & Patrick.	Ohio, southern district.	Shipment of adulterated and misbranded vanilla extract from Ohio to Indiana.	Defendant plead guilty; the 2 partners were each fined $5.

CONDEMNATION.

Cases under the food and drugs act of June 30, 1906, reported for condemnation and finally determined or pending in the courts at the close of the fiscal year from July 1, 1907, to June 30, 1908.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
4	Semmes-Kelly Co.	District of Columbia.	135 barrels of misbranded apple cider, offered for sale in the District of Columbia.	Decree of forfeiture and condemnation rendered.
15	James Clark Distilling Co.	.....do............	45 barrels of adulterated and misbranded whisky offered for sale in the District of Columbia.	Libel filed, seizure effected, case pending for trial at fall term, 1908.
16	Southern Coffee Mills.	Tennessee, middle district.	Car of adulterated coffee shipped from Louisiana to Tennessee for sale.	Decree of forfeiture; condemnation and destruction rendered.
17	Seymour-Carter...	Indiana...........	Car of misbranded flour shipped from Minnesota to Indiana for sale.	Seizure effected; goods released on payment of costs; flour of same brand condemned in Illinois.
18	.....do............	Illinois, northern district.	Car of misbranded flour shipped from Minnesota to Illinois for sale.	Decree of forfeiture and condemnation rendered.
19	C. H. Godfrey & Son.	Missouri, western district.	242 cases of canned blackberries and 100 cases of canned apples, misbranded as to place of production, shipped from Arkansas to Missouri for sale.	Libel filed and goods seized; pending.
20	Rogers, Holloway Co.	Michigan, eastern district.	224 cases of misbranded honey shipped from Pennsylvania to Michigan for sale.	Decree of forfeiture and condemnation rendered.
22	Western Reserve Syrup Co.	Michigan, western district.	20 dozen quarts, 2 dozen gallons, 10 cases of pints, and 6 cases of quarts of misbranded and adulterated maple sirup shipped from Ohio to Michigan.	Libel filed; seizure effected; pending.
23	Sweet Valley Wine Co.; A. Schmidt, Jr., Bros. Wine Co.; John G. Dorn, et al.	Louisiana, eastern district.	1,293 barrels of adulterated and misbranded wine, shipped from Ohio to Louisiana for sale.	Decree of forfeiture and condemnation rendered.
31	U. S. Coffee Refining Co.	Massachusetts.....	1,000 cases of misbranded coffee shipped from New York to Massachusetts for sale.	Do.
33	Penick & Ford....	Tennessee, western district.	18 barrels of adulterated and misbranded molasses shipped from Louisiana to Tennessee for sale.	Do.
35	Joseph Fallert Brewing Co.	New York, eastern district.	50 cases of misbranded beer delivered for shipment from New York to Cuba for sale.	Do.
38	Orrville Milling Co.	District of Columbia.	240 sacks of misbranded flour shipped from Ohio to the District of Columbia for sale.	Do.
89	.....do............	Virginia, eastern district.	800 sacks of misbranded flour shipped from Ohio to Virginia for sale.	Libel filed and goods seized May 1, 1908; pending.
90	O. L. Gregory Vinegar Co.	Kentucky, western district.	10 barrels, 75 half barrels, and 50 kegs of misbranded cider shipped from Ohio to Kentucky for sale.	Decree of forfeiture and condemnation rendered.
91	Roosevelt & Schuyler.	New York, southern district.	220 cases of adulterated and misbranded whisky shipped from Scotland to New York.	Libel filed and seizure effected; pending.
91a	I. C. Bishop.......	.....do............	125 cases of adulterated and misbranded whisky shipped from Scotland to New York for sale.	Libel filed June, 1908, and seizure effected; pending.
91b	Thomas Massey & Co.	Pennsylvania, eastern district.	125 cases of adulterated and misbranded whisky shipped from Scotland to Pennsylvania for sale.	Do.
92	P. Meyer..........	New York, eastern district.	100 cases of adulterated and misbranded whisky shipped from Michigan to New York for sale.	Libel filed, June, 1908; pending.
96	Reily-Taylor Co...	Georgia, northern district.	36 cases of adulterated and misbranded coffee shipped from Louisiana to Georgia for sale.	Libel filed and seizure effected; pending.

Cases under the food and drugs act of June 30, 1906, etc.—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
97	C. Person's Sons...	New York, western district.	88 cases of adulterated and misbranded whisky shipped from Canada to New York for sale.	Decree of forfeiture and condemnation rendered.
102	Adam Dillman & Co.	Wisconsin, eastern district.	51 cases of adulterated and misbranded whisky shipped from Michigan to Wisconsin for sale.	Libel filed and seizure effected; pending.
106	Thos. Massey & Co.	Pennsylvania, eastern district.	88 cases of adulterated and misbranded whisky shipped from Michigan to Pennsylvania for sale.	Do.
108	S. Rosenbloom & Co.	Pennsylvania, western district.	50 cases of adulterated and misbranded whisky shipped from Michigan to Pennsylvania for sale.	Do.
114	Capital Grain and Mill Co.	Virginia, eastern district.	500 bags of adulterated and misbranded animal food shipped from Tennessee to Virginia for sale.	Decree of forfeiture and condemnation rendered.
115	Knowlton Danderine Co.	West Virginia, northern district.	65 casks of misbranded drugs shipped from Michigan to West Virginia for sale.	Libel filed and seizure effected; pending.
125	Bloomington Canning Co.	Missouri, western district.	100 cases of misbranded corn and 778 cases of misbranded beans shipped from Illinois to Missouri for sale.	Decree of forfeiture and condemnation rendered.

NOTICES OF JUDGMENT.

In addition to the work incident to the preparation of the foregoing cases and the subsequent correspondence in reference thereto, the Solicitor assisted in drafting the several notices of judgment, provided for by section 4 of the food and drugs act, published during the year. The demand for these notices is very great, and it is apparent that manufacturers and dealers are closely watching the operation of the law. It is the publication of these that operates to deter many who would otherwise take the chances of the mere payment of a fine.

ATTEMPT TO ENFORCE ROAD DUTIES UPON A MEAT INSPECTOR OF THE DEPARTMENT.

During the last month of the previous fiscal year W. F. McCarty, a meat inspector of the Department temporarily on duty in Greenville, Tex., was summoned by the marshal of that city, under color of an ordinance then in force, to work the streets for five days. Mindful of the duties of his position, which required his constant and daily attention, and of his citizenship and residence in the State of Illinois, he respectfully refused to comply with the summons, stating fully his reasons to the city authorities. Despite his explanations he was duly arrested and held for trial in the mayor's court for failure to respond to the summons. Upon his report of these facts the Department requested the Attorney-General to instruct the United States attorney for the northern district of Texas to appear in the mayor's court in behalf of McCarty and to resist the proceeding. This was done, but without avail, and sentence was duly passed upon him. The United States attorney promptly applied to the district judge for the eastern district of Texas for a writ of habeas corpus, and on

September 3, 1907, the writ was granted and the matter closed. There was some disposition on the part of the local authorities to appeal, but it was abandoned. This Office carefully investigated the law applicable to the case and furnished the United States attorney with the few authorities available bearing upon the questions involved.

GENERAL CORRESPONDENCE WITH THE DEPARTMENT OF JUSTICE AND THE UNITED STATES ATTORNEYS.

In addition to the general superintendence of the Secretary's correspondence with the Department of Justice, the Solicitor submitted several briefs during the year to accompany requests of the Secretary for opinions of the Attorney-General touching the duties of the Department in the administration of the laws committed to it for execution. These briefs were prepared in conformity with the letter of the Attorney-General of October 15, 1906, to the Secretary requesting that this be done.

ORDERS AND REGULATIONS.

One of the duties of the Solicitor under the general order of the Secretary of June 17, 1905, is to examine and verify the legality, in advance of issue, of all orders and regulations affecting the public promulgated by the Secretary under statutory authority.

MEAT-INSPECTION LAW.

The regulations of the Secretary of Agriculture governing the meat inspection of the Department, under the act of June 30, 1906, in force during the preceding year and part of the present year, were extensively revised during the year and reissued as Order No. 150 of the Bureau of Animal Industry. In the formulation and preparation of these regulations for promulgation the Solicitor cooperated with the Bureau of Animal Industry. Much time and exacting care were required in this work.

PURE FOOD LAW.

The basis of the series of publications designated as "Food Inspection Decisions" was stated in the last report of the Office. These decisions are prepared by the Board of Food and Drug Inspection, of which the Solicitor is one of the three members. Considerable time was devoted by this Office to these publications during the year. There were 23 decisions prepared and published, one of which, F. I. D. No. 86, "Original Packages: Interpretation of regulation 2 of rules and regulations for the enforcement of the food and drugs act," was wholly prepared by this Office, and is in the nature of a legal brief covering the law of the relation of the original package to interstate commerce. Its preparation was necessitated by the erroneous interpretation, so widely prevalent, placed upon the language of regulation 2 of the rules and regulations for the enforcement of the act. The work necessitated in the drafting of this decision involved a careful review of all the leading Federal cases on the subject of interstate commerce, and consumed some weeks of close application and painstaking care. It is a matter of satisfaction to report that the decision has met with the most favorable and flattering reception, both by the profession and laymen, and has been of great value to the United States attorneys handling the cases reported to them under the act.

As a member of the Board of Food and Drug Inspection much of the time of the Solicitor during the year was spent in consideration of the numerous cases and questions coming before the Board.

CATTLE QUARANTINE LAWS.

Several of the orders of the Secretary, under the animal quarantine acts, were revised during the year, and in some instances new orders prepared. The Solicitor cooperates with the Bureau of Animal Industry in the drafting of these orders.

LEGAL PAPERS.

The operations of the Department, partially reflected in the number and character of its contracts, have steadily increased since the last fiscal year, and as a necessary consequence the work of the Office has grown correspondingly.

This Office prepares all the contracts of the Department and exercises supervision over them until final execution, and a careful record is preserved of all contracts and leases in force. In those instances where these instruments are, by their terms, renewable at the option of the Secretary, notice is given to the proper Bureau, Division, or Office sufficiently in advance to permit renewal within the terms stipulated, if desired.

GENERAL CONTRACTS.

Supplies.—The supplies for the equipment and conduct of the business of the Department are procured upon competitive bidding and upon award to the successful bidder, under contracts, usually guaranteed by a bond. Many of these contracts are made with contractors unfamiliar with the method of executing them, and it frequently becomes necessary, despite the plain directions accompanying the instruments, to return them to the contractors with more explicit directions as to the manner of execution.

Of these contracts there were 124 prepared and perfected during the year, an increase of 18 over the preceding year.

Telephone service.—Certain amendments to the annual contract with the Chesapeake and Potomac Telephone Company for the Department's telephone service were made during the year.

Removal of old buildings.—The removal of the old annex building, incident to completion and occupancy of the Department's new buildings, was effected, under contract prepared by the Office.

Amendments to new buildings contract.—Two contracts with the Otis Elevator Company were prepared during the year covering payment of percentages to the contractors for completed portions of the elevators in the new buildings.

CONTRACTS FOR THE SEVERAL BUREAUS AND OFFICES.

The past fiscal year witnessed a marked extension in the operations of several of the Bureaus and Offices, necessitating the preparation of a larger number of leases and bonds than in former years. There was a slight diminution in the number of contracts.

Bureau of Plant Industry.—There were 107 contracts, 48 renewals of contracts, 52 leases, 18 renewals of leases, and 7 bonds prepared and perfected for the Bureau of Plant Industry during the year, a decrease of 29 contracts from the previous year, and an increase of 28 leases. These contracts and leases cover a wide range of experiments and involve many questions requiring the most careful preparation of the instruments.

Bureau of Animal Industry.—The contracts of the Bureau of Animal Industry relate almost exclusively to experiments in animal breeding and feeding and extermination of diseases. A large portion of these experiments is conducted in cooperation with State institutions and with public-spirited individuals. The leases of this Bureau relate largely to office accommodation for offices required in the administration of the meat inspection and cattle quarantine laws. During the year there were prepared and perfected 20 contracts, 7 renewals of contracts, 39 leases, 31 renewals of leases, and 1 bond, a decrease of 5 contracts and 1 lease from the previous year.

Weather Bureau.—During the year 5 contracts and 1 bond were prepared and perfected for the Weather Bureau and 15 contracts, 20 leases, 94 renewals of leases, and 2 bonds were examined, corrected when necessary, and approved. The contracts and bonds prepared represent a net increase over the previous year, with an increase of 11 in the leases examined.

Forest Service.—There were 21 leases, 6 renewals of leases, and 55 bonds prepared and perfected for the Forest Service. The contracts and renewals represent a net increase over the previous year, none having been prepared during that time.

Bureau of Chemistry.—Extension of the work of the Bureau of Chemistry during the year necessitated the rental of a considerably larger number of offices and laboratories for work under the food and drugs act than in the previous year. There were 21 contracts, 24 leases, 17 renewals of leases, and 1 bond prepared and perfected during the year, a decrease of 5 contracts and an increase of 31 leases over the number for the previous year.

Office of Experiment Stations.—During the year there were prepared for the Office of Experiment Stations 5 contracts, 3 renewals of contracts, 5 leases, 3 renewals of leases, and 1 bond, an increase of 2 contracts and 4 leases over the previous year.

Bureau of Entomology.—There were prepared and perfected for the Bureau of Entomology 9 contracts, 2 renewals of contracts, 30 leases, and 13 renewals of leases, a decrease of 9 contracts and an increase of 37 leases over the number for the previous year.

of Public Roads.—There were 1 contract and 1 lease pre-
d perfected for the Office of Public Roads, a decrease of 2
and 3 leases from the number for the previous year.

Division of Publications.—One contract, 1 lease, and 1 renewal of lease were prepared and perfected for the Division of Publications, an increase of 1 contract and a decrease of 1 lease in the number for the previous year.

Bureau of Soils.—One lease was prepared and perfected for the Bureau of Soils, a decrease of 2 from the number for the previous year.

Division of Accounts.—Two bonds were prepared for the Division of Accounts. There was none during the previous year.

Library.—One contract, for installation of book racks in the new building, was prepared for the Library. There was none in the previous year.

Office of the Chief Clerk.—There was one contract prepared and perfected for the Chief Clerk.

RECAPITULATION OF CONTRACTS AND LEASES.

The accompanying table is a recapitulation of the foregoing contracts and leases prepared by this Office during the year, with a restatement, for purposes of comparison, of these instruments prepared during the fiscal year 1907.

Recapitulation and comparative table of contracts and leases prepared during the fiscal years 1908 and 1907.

Department, Bureau, Division, or Office.	1908.		1907.	
	Contracts.	Leases.	Contracts.	Leases.
Department	128		107	
Bureau of Plant Industry	155	70	184	32
Bureau of Animal Industry	27	70	32	72
Weather Bureau	5			
Weather Bureau (examined)	15	114	59	103
Forest Service		27	1	15
Division of Publications	1	2		3
Bureau of Chemistry	21	41	26	10
Office of Experiment Stations	8	8	6	4
Bureau of Entomology	11	43	20	6
Bureau of Soils		1		3
Office of Public Roads	1	1	3	4
Library	1			
Office of Chief Clerk	1			1
Total	374	377	438	253

Total contracts and leases in 1908	751
Total contracts and leases in 1907	691
Increase in 1908	60

BONDS.

The act of March 2, 1895 (28 Stats., 807), requires the reexamination every two years of all bonds of officers and employees of the Department for the purpose of ascertaining the sufficiency of the sureties thereon. A number of bonds within the terms of this act were examined for approval or renewal during the year.

The act of February 24, 1905 (33 Stats., 812), amending the act of August 13, 1894 (28 Stats., 278), requires all contractors with the

Government, for erection or repair of any public buildings or works, to furnish a bond for the faithful performance thereof, and the prompt payment to all persons supplying them with labor or materials in the prosecution of the work. Upon the default of the contractor in payment and failure of the United States for six months to bring suit upon the bond, the person who has furnished the labor or materials may file an affidavit with the Department under whose direction the work was done, setting forth the facts of furnishing such labor and materials, and nonpayment therefor, and procure a certified copy of the contract and bond, upon which suit may be brought in the name of the United States for the use and benefit of such person. All the contracts of the Department within the scope of this act are secured by bonds containing the obligation above set forth. Aside from the benefit accruing to the Government under this statute, persons furnishing labor or materials usually find their only hope of payment in the action thus secured to them. During the year several applications were received for certified copies of contracts and bonds covering construction of buildings and performance of work for the Department. Several of the applications were unaccompanied by the required affidavit and it was apparent from the letters of the applicants that they were not well acquainted with the requirements of the act.

The total number of bonds prepared during the year amounted to 70, an increase of 56 over the previous year.

ASSISTANCE IN LEGAL PROCEEDINGS.

During the year this Office has rendered assistance to the United States attorneys handling the cases reported for prosecution by the Department. This has amounted in numerous instances to the preparation of exhaustive legal briefs upon which the cases have been partially, if not wholly, submitted. Pleadings have been examined and, where necessary, suggestions for amendments have been made, and stipulations of facts, in several cases, have been prepared. In addition to these, representatives from the Office have attended and assisted in the conduct of the trials of some of the more important cases. The effort is made to keep in close touch with the United States attorneys and thereby to maintain at all times accurate information of the status and progress of the Department's cases. It is a pleasure to report that the relations of the Office with the United States attorneys have been cordial and effective, and the Department has received from them its full share of active, careful, and considerate attention to its cases.

The negligent killing of a horse and damage to a buggy belonging to the Department was investigated by the Office during the year. It appeared that on January 27, 1908, the inspector in charge of the administration of the meat inspection law in the District of Columbia left his horse and buggy standing, properly secured, at the edge of the sidewalk on C street, in Washington, during a short absence for lunch. While thus away a part of an adjoining building crumbled and fell upon the horse and buggy, killing the former and injuring the latter. The facts were reported to the United States attorney and immediate demand was made by him upon the owner of the building for damages, resulting in the collection of $242.50, the value of the horse and amount expended in repairs to the buggy.

PATENTS FOR DEPARTMENT EMPLOYEES.

As explained in the last report of the Office, applications for patents for inventions of employees of the Department, perfected in connection with their official work, are prosecuted by the Solicitor. These patents allow the use by any person in the United States of the discovery without the payment of any royalty or fees to the inventor. During the year just closed the prosecution of applications for patents and examinations of patentability of inventions of employees of the Department were material features of the work of the Office. Five applications were made during the preceding year and seven during the year just closed. During the year two patents were granted, two applications rejected, and four applications were pending at its close. The appended table shows the details of the applications:

Applications for patents prosecuted by the Solicitor, for Department employees, during fiscal year ended June 30, 1908.

Applicant.	Bureau or Office.	Invention.	Disposition of application.
A. S. Cushman	Public Roads	Process for preventing the rusting of iron and steel.	Patent disallowed.
John M. Nelson, jr.	Forest Service	Improvement in the process for the treatment of timber with liquid preservatives.	Pending.
H. B. Shaw	Plant Industry	Method for separating weed seeds from other seeds.	Patent disallowed.
A. W. Morrill	Entomology	Improvement in fumigating tents and process of using same.	Patent granted May 19, 1908 (No. 408670).
W. E. Hinds	do	Cultivator for destroying cotton boll weevils.	Patent granted May 25, 1908 (No. 421954).
A. G. McAdie	Weather Bureau	Method for assisting forecasters in preparation of weather maps, charts, bulletins, etc.	Pending.
J. W. T. Duvel	Plant Industry	Improvement in laboratory balances	Do.
A. F. Martins	Animal Industry	Device for stamping meats	Do.

COMMITTEE ON PERSONNEL.

As a member of the committee on personnel the Solicitor was engaged during the year with the other members of the committee in the investigations incident to six cases submitted to the committee for action. The investigations of this committee have had a salutary effect upon the deportment and efficiency of the employees of the Department, and the scheme has proven to be a complete success in relieving the Secretary of the burden of personally conducting the hearings in the cases. The committee hears the evidence, has it reduced to writing, and files its report of findings with the appropriate recommendation for the action of the Secretary.

PUBLICATIONS.

During the year the long-felt need of a compilation of the laws affecting the Department was fulfilled by the preparation in the Office of a volume of 255 pages, with an exhaustive index, containing all the laws, resolutions, and executive orders of the United States applicable to the Department of Agriculture. The usefulness of the compilation in the brief period since its publication has demonstrated the wisdom of its preparation. It was intended for the information of all the officers of the Department, and its arrangement and index have greatly facilitated its ready and intelligent use.

As heretofore stated in this report, the questions presented in the suits under the twenty-eight hour law during the year were numerous and important, and their favorable determination for the Government was vital to the enforcement of the act. In the large number of cases pending in various judicial districts during the year frequent opinions of the courts upon the proper construction of the act were rendered, but many of them were of such a character that they would not be reported in the ordinary course, and those that were to be reported were so delayed that their immediate availability was not to be secured. As a decision upon questions arising in one district was of great weight in another where similar questions were pending, it was a matter of importance that it be immediately available for use of the United States attorneys handling the cases, and as a means of supplying it the Office adopted a scheme of circulars embodying the entire decision. As soon as a decision was rendered a typewritten copy was procured and published at the Department and distributed to the United States attorneys as speedily as possible. The value of these circulars was abundantly demonstrated in the assistance they furnished the United States attorneys and in the use the courts made of them. At the close of the year seven of these circulars had been issued.

STATE OF OFFICE WORK.

The work of the office at the close of the year was current and in good shape. The employees of the Office are competent, painstaking, and willing. The work is increasing to such an extent that it will be necessary in the near future to provide for additional assistance.

REPORT ON BUILDING OPERATIONS.

U. S. Department of Agriculture,
Office of Chairman of Committee on Buildings,
Washington, D. C., November 13, 1908.

Sir: I have the honor to submit herewith a brief statement covering the work for the last year connected with the building operations of the Department of Agriculture authorized by the act of Congress approved February 9, 1903, and other work of the Committee on Buildings.

Respectfully,
B. T. Galloway,
Chairman, Committee on Buildings.

Hon. James Wilson,
Secretary of Agriculture.

NEW BUILDING WORK.

Supervision of the work.—Up to April 24, 1908, the new building work of the Department of Agriculture continued in charge of the Building Committee appointed by the Secretary of Agriculture, which consisted of Mr. Gifford Pinchot, Forester of the Department, Dr. A. C. True, Director of the Office of Experiment Stations, and the writer, who, being designated as chairman of the committee, in such capacity made all necessary recommendations, prepared requests for authorizations, requisitions, etc., and attended to the necessary details in connection with the work.

The general construction work was continued in charge of Maj. John Stephen Sewell, Corps of Engineers, U. S. Army, as supervising engineer, and the mechanical equipment work in charge of Messrs. R. Barnard Talcott and S. Franklin Gardner. Mr. J. G. Palmer, inspector, was in immediate charge of the construction work under Major Sewell. After the acceptance of the building, the general construction work being practically completed, by special order of the Secretary, dated April 24, 1908, the Building Committee was dissolved and a committee to be known as the Committee on Buildings, to consist of Col. S. R. Burch, Mr. A. Zappone, and the writer, designated as chairman of the committee, was appointed to handle all matters relative to the buildings of the Department. Since this date the Committee on Buildings has taken up the work on the new building and given consideration to all matters relative to the other buildings occupied by the Department.

General construction contract.—The date for the completion of the general construction contract was November 29, 1907. This work was delayed, but on March 17, 1908, the building was provisionally accepted, subject to the completion of a few minor items of unfinished work that interfered in no way with the occupancy of the building. These minor details of unfinished work were completed shortly after the building was occupied and final payment on the general construction contract was made.

Mechanical equipment work.—The mechanical contracts covering the heating, ventilating, and special piping systems, the electric wiring and conduit systems, the elevators, lighting fixtures, power house, and the power-plant equipment have all been satisfactorily completed and final payments have been made on the same.

Owing to uncertainty as to the available balance of the building fund, which could not be determined exactly until the general construction contract was entirely completed, certain items of work desired to complete the mechanical plant and approaches to the building had to be deferred until the building proper had been accepted. Your committee has therefore, since the building has been accepted, undertaken such items of work in the mechanical plant as were contemplated in the original specifications for the mechanical equipment.

A contract for an additional boiler was awarded under date of July 1, 1908, to the E. Keeler Company, of Williamsport, Pa., in amount $2,771. This boiler has been entirely installed and is in satisfactory operation.

A contract for mechanical stokers was awarded under date of July 16, 1908, to the Underfeed Stoker Company of America, in amount $4,870. This contract has been completed and the stokers are in satisfactory operation. The installation of these stokers permits the burning of bituminous coal without smoke at a much lower cost than if anthracite coal were used.

A contract for vacuum cleaning machinery was awarded under date of October 2, 1908, to the Blaisdell Machinery Company, Bradford, Pa., in amount $3,987. This contract is now being executed, the date for completion being December 1, 1908.

Approaches to new building.—The bill for the new building provides for the arrangement of approaches to the building and the removal of the adjacent old buildings. Your committee has therefore inaugurated this work, and several frame buildings, together with the brick seed warehouse at the corner of Fourteenth and B streets SW., have been removed.

The contract for the removal of the seed warehouse was awarded under date of September 19, 1908, to Mr. T. Edward Clark, in amount $1,200.

There are still several frame structures adjacent to the new building which will be removed upon completion of the shop and stable building now being constructed, after which suitable walks will be constructed to the new building and the surrounding ground properly graded and surfaced.

FINANCIAL STATEMENT.

Total of appropriations for new building	$1,500,000.00
Total expenditures and outstanding liabilities on November 13, 1908 (estimated)	1,495,289.37
Total available balance on November 13, 1908 (estimated)	4,710.63

MISCELLANEOUS WORK.

Shop building.—The appropriation bill for the Department for the present fiscal year provided for the construction of a suitable building for shops, stables, and storage at a cost not to exceed $25,000. The construction of this building has been undertaken by your committee, and the contract for general construction was awarded to Messrs. Newman & Smith, in amount $17,200, this proposal being the lowest of nine proposals received. This contract covers all labor and material except brick, lumber, and certain other materials to be furnished by the Department. By this arrangement the Department was able to utilize the old brick, lumber, windows, etc., from the old seed warehouse in the construction of this new building. The contract date for the completion of this work is December 1, 1908, and the work has progressed in a satisfactory manner and the building will probably be completed within contract time.

Rented quarters.—Your committee has had in hand the securing of desirable rented quarters for such portions of the work as could not be housed in the Department buildings, and several buildings immediately south of the Department grounds have been secured and are now occupied.

The space occupied by the Bureau of Chemistry, for the most part in several small buildings, has been for some time inadequate and unsuitable for the important work of this Bureau. In order to centralize this work and secure necessary and suitable space, a lease has been executed for a fireproof five-story and basement building now under construction at No. 216 Thirteenth street SW. This building will be occupied by the Bureau of Chemistry as soon as completed.

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